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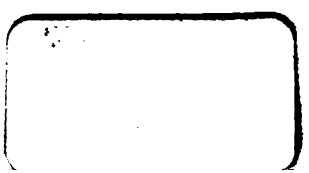

# MEDICO-CHIRURGICAL

# TRANSACTIONS,

PUBLISHED BY THE

## ROYAL

## MEDICAL AND CHIRURGICAL SOCIETY

OF

## LONDON.

VOLUME THE THIRTY-FIRST.

LONDON:
PRINTED FOR LONGMAN, BROWN, GREEN, AND
LONGMANS, PATERNOSTER-ROW.

1848.

RICHARD KINDER, PRINTER,
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# ROYAL
# MEDICAL AND CHIRURGICAL SOCIETY
## OF LONDON.

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## THE QUEEN.

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FOR THE SESSION OF 1847-8.

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WATSON, THOMAS, M.D.

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1805. WILLIAM SAUNDERS, M.D.
1808. MATTHEW BAILLIE, M.D.
1810. SIR HENRY HALFORD, Bart., M.D., G.C.H.
1813. SIR GILBERT BLANE, Bart., M.D.
1815. HENRY CLINE.
1817. WILLIAM BABINGTON, M.D.
1819. SIR ASTLEY PASTON COOPER, Bart., K.C.H., D.C.L.
1821. JOHN COOKE, M.D.
1823. JOHN ABERNETHY.
1825. GEORGE BIRKBECK, M.D.
1827. BENJAMIN TRAVERS.
1829. PETER MARK ROGET, M.D.
1831. WILLIAM LAWRENCE.
1833. JOHN ELLIOTSON, M.D.
1835. HENRY EARLE.
1837. RICHARD BRIGHT, M.D.
1839. SIR BENJAMIN COLLINS BRODIE, Bart.
1841. ROBERT WILLIAMS, M.D.
1843. EDWARD STANLEY.
1845. WILLIAM F. CHAMBERS, M.D., K.C.H.
1847. JAMES MONCRIEFF ARNOTT.

# FELLOWS

OF THE

# ROYAL

# MEDICAL AND CHIRURGICAL SOCIETY

# OF LONDON.

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EXPLANATION OF THE ABBREVIATIONS.

| | |
|---|---|
| P.—President. | V.P.—Vice-President. |
| T.—Treasurer. | S.—Secretary. |
| L.—Librarian. | C.—Member of Council. |

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*AUGUST* 1848.

Amongst the non-residents, those marked thus (*) are entitled by composition to receive the Transactions.

ELECTED

1841 *James Abercrombie, M.D., *Cape of Good Hope.*

1846 *John Abercrombie, M.D., *Physician to the General Dispensary, Cheltenham; Cheltenham.*

1827 Elesis Acosta, M.D., *Caraccas.*

1842 William Acton, *Surgeon to the Islington Dispensary;* 46, *Queen Anne-street, Cavendish-square.*

1818 Walter Adam, M.D., *Physician to the Royal Public Dispensary, Edinburgh.*

1818 Thomas Addison, M.D., *Physician to, and Lecturer on Medicine at, Guy's Hospital;* 24, *New-street, Spring-gardens.* C. 1826. V.P. 1837.

1814 Joseph Ager, M.D., *Great Portland-street.* C. 1836.

1819 *James Ainge, *Fareham, Hants.*

1837 *Ralph Fawsett Ainsworth, M.D., 104, *King-street, Manchester.*

ELECTED

1819 George F. Albert.

1839 Rutherford Alcock, K.C.T., K.T.S., *China.*

1826 James Alderson, M.D., F.R.S., 36, *Charles-street, Berkeley-square.* S. 1828. C. 1848.

1843 C. J. B. Aldis, M.D., *Physician to the London and Surrey Dispensaries, and Lecturer on Medicine at the Hunterian School of Medicine;* 1, *Chester-terrace, Chester-square.*

1813 Henry Alexander, F.R.S., *Surgeon-Oculist in Ordinary to the Queen, and Surgeon to the Royal Infirmary for Diseases of the Eye;* 6, *Cork-street.* C. 1840.

1836 Henry Ancell, 3, *Norfolk-crescent, Oxford-square.* C. 1847.

1817 Alexander Anderson.

1816 John Goldwyer Andrews, *Surgeon to the London Hospital;* 4, *St. Helen's-place.* C. 1836. V.P. 1840.

1820 Thomas F. Andrews, M.D., *Norfolk, Virginia.*

1813 William Ankers, *Knutsford.*

1819 Professor Antommarchi, *Florence.*

1818 William Withering Arnold, M.D., *Physician to the Infirmary and Lunatic Asylum, Leicester.*

1825 Thomas Graham Arnold, M.D., *Stamford.*

1819 James M. Arnott, F.R.S., PRESIDENT; *Professor of Surgery at University College, and Surgeon to University College Hospital;* 2, *New Burlington-street.* L. 1826. T. 1825. V.P. 1832. C. 1846. P. 1847.

1828 Neil Arnott, M.D., F.R.S., *Physician Extraordinary to the Queen;* *Bedford-square.* C. 1835.

1817. John Ashburner, M.D., M.R.I.A., *Physician-Accoucheur to the Queen Charlotte's Lying-in-Hospital;* 65, *Grosvenor-street.* C. 1821.

1848 James Ramsay Atkins, *Grove House, Stoke Newington-green.*

1841 John Avery, *Surgeon to the Charing-cross Hospital;* 3, *Queen-street, May-fair.*

1825 Benjamin Guy Babington, M.D., F.R.S., TREASURER; *Physician to Guy's Hospital, and Physician to the Deaf and Dumb Institution;* 31, *George-street, Hanover-square.* C. 1829. V.P. 1845.

1846 C. S. Metcalfe Babington, *Surgeon-Accoucheur to the St. George's and St. James's Dispensary, and Lecturer on Midwifery at the Middlesex Hospital;* 2, *Chester-street, Belgrave-square.*

1819 John Carr Badeley, M.D., *Chelmsford.*

ELECTED

1820 *John H. Badley, *Dudley.*

1838 Francis Badgley, M.D., *Montreal, Upper Canada.*

1840 William Bainbridge, *Upper Tooting.*

1836 Andrew Wood Baird, M.D., *Ipswich.*

1816 *William Baker, M.D., *Physician to the Derbyshire General Infirmary; Derby.*

1839 T. Graham Balfour, M.D., *Grenadier Guards, Army and Navy Club, St. James's-square.*

1848 Edward Ballard, M.D., *Physician to the St. Pancras General Dispensary;* 64, *Gower-street, Bedford-square.*

1837 William Baly, M.D., F.R.S., SECRETARY; *Physician to the Millbank Prison, and Lecturer on Forensic Medicine at St. Bartholomew's Hospital;* 28, *Spring-gardens.* C. 1845. L. 1847. S. 1848.

1847 Andrew Whyte Barclay, M.D., *Physician to the Chelsea Dispensary;* 42, *Curzon-street, May-fair.*

1833 Thomas Alfred Barker, M.D., *Physician to, and Lecturer on Medicine at, St. Thomas's Hospital; Grosvenor-street.* C. 1844.

1848 .Edgar Barker, 40, *Edgware-road.*

1843 Thomas Herbert Barker, *Priory-terrace, Bedford.*

1847 George Hilaro Barlow, M.D., *Physician to Guy's Hospital;* 5, *Union-street, Southwark.*

1843 Christopher Hewetson Barnes, E.I.C.S.; *Belle-Vue House, Notting-hill.*

1815 *John Baron, M.D., *Cheltenham.*

1840 Benjamin Barrow, *Ryde, Isle of Wight.*

1844 William R. Basham, M.D., *Physician to, and Lecturer on Materia Medica at, the Westminster Hospital; Chester-street, Grosvenor-place.*

1836 William Beaumont, *Professor of Surgery in the University of King's College; Toronto, Upper Canada.*

1841 George Beaman, 32, *King-street, Covent-garden.*

1840 Charles Beevor, *Surgeon to the St. Marylebone Dispensary;* 49, *Berners-street.*

1819 Thomas Bell, F.R.S., L.S., and G.S., *Lecturer on Diseases of the Teeth, at Guy's Hospital;* 17, *New Broad-street.* C. 1832.

1847 Henry Bennet, M.D., *Physician-Accoucheur to the Western General Dispensary; Cambridge-square, Hyde-park.*

1845 Edward Unwin Berry, *James-street, Covent-garden.*

ELECTED

1820 Stephen Bertin, *Paris.*

1827 William Birch, *Barton, Lichfield.*

1845 Golding Bird, M.D., F.R.S., *Assistant-Physician to, and Lecturer on Materia Medica at, Guy's Hospital; Myddelton-square.*

1835 James Bird, 16, *Orchard-street, Portman-square.*

1846 Hugh Birt, *Morro Velhio, Minus Quæes, Rio Janeiro, Brazil; Surgeon to the Morro Velhio Hospital.*

1843 Patrick Black, M.D., *Assistant-Physician to St. Bartholomew's Hospital, and Physician to the Seamen's Hospital Ship "Dreadnought;" Bedford-square.*

1844 Thomas Blackall, M.D., *Physician to the Pimlico Dispensary, and to the Seamen's Hospital Ship "Dreadnought;" Queen-street, May-fair.*

1847 George C. Blackman, M.D., *New York, U.S.*

1839 Richard Blagden, *Surgeon-Accoucheur, and Surgeon Extraordinary, to the Queen; Surgeon in Ordinary to Her Royal Highness the Duchess of Kent; Albemarle-street.* C. 1847.

1814 Thomas Blair, M.D., *Physician to the Sussex County Hospital; Brighton.*

1841 James Blake.

1840 Peyton Blakiston, M.D., F.R.S., *Birmingham.*

1845 Henry Blenkinsop, *Warwick.*

1811 *Henry C. Boisragon, M.D., *Cheltenham.*

1823 Louis Henry Bojanus, M.D., *Wilna.*

1816 Hugh Bone, M.D., *Inspector-General of Hospitals, Edinburgh.*

1810 John Booth, M.D., *Physician to the General Hospital at Birmingham.*

1846 John Ashton Bostock, *Scots Fusileer Guards.*

1846 Peter Bossey, *Thomas-street, Woolwich.*

1841 William Bowman, F.R.S., *Professor of Physiology and General Anatomy at King's College, and Assistant-Surgeon to King's College Hospital, and to the Royal Ophthalmic Hospital, Moorfields;* 14, *Golden-square.*

1844 Robert Brandon, 23, *Upper Seymour-street West, Edgware-road.*

1814 Richard Bright, M.D., F.R.S., *Physician Extraordinary to the Queen, and Consulting Physician to Guy's Hospital; Saville-row.* C. 1821. V.P. 1827. P. 1837.

1813 Sir Benjamin Collins Brodie, Bart., F.R.S., *Serjeant-Surgeon*

ELECTED

*to the Queen, Surgeon in Ordinary to His Royal Highness Prince Albert, Foreign Correspondent of the Institute of France, and Foreign Associate of the Royal Academy of Medicine of Paris; Saville-row.* C. 1814. V.P. 1816. P. 1839.

1844 Charles Brooke, F.R.S., *Keppel-street, Russell-square.*

1848 William Philpot Brookes, M.D., *Surgeon to the Cheltenham General Hospital and Dispensary, and Visiting Medical Officer to the Cheltenham District of Lunatic Asylums; Albion House, Cheltenham.*

1847 George Brown, *Grenadier Guards Hospital; Rochester-row, Westminster.*

1847 *Robert Brown, *Winckley-square, Preston, Lancashire.*

1842 Charles Blakely Brown, M.B., *Physician-Accoucheur to the St. George's and St. James's Dispensary;* 38, *Hill-street, Berkeley-square.*

1818 *Samuel Barwick Bruce, *Surgeon to the Forces; Ripon.*

M. Pierre Brulatour, *Surgeon to the Hospital; Bordeaux.*

1823 B. Bartlet Buchanan, M.D.

1843 J. Charles Bucknill, M.B., *Exminster, Devonshire.*

1839 George Budd, M.D., F.R.S., *Fellow of Caius College, Cambridge; Professor of Medicine in King's College, London; Physician to King's College Hospital;* 20, *Dover-street, Piccadilly.* C. 1846.

1839 Thomas Henry Burgess, M.D.

1833 George Burrows, M.D., F.R.S., *Physician to, and Lecturer on Medicine at, St. Bartholomew's Hospital;* 45, *Queen Anne-street.* C. 1839. T. 1845.

1820 Samuel Burrows.

1835 Henry Burton, M.D., *Physician to St. Thomas's Hospital;* 41, *Jermyn-street.* C. 1842.

1837 George Busk, *Surgeon to the Hospital-ship "Dreadnought;" Croom's Hill, Greenwich.* C. 1847.

1818 John Butter, M.D., F.R.S., F.L.S., *Physician to the Plymouth Eye Infirmary; Plymouth.*

1832 *William Campbell, M.D., *Physician to the New Town Dispensary, and Lecturer on Midwifery; Edinburgh.*

1842 Henry Cantis, 8, *Maddox-street, Hanover-square.*

1846 John Burford Carlill, 57, *Berners-street.*

1839 Robert Carswell, M.D., *Physician to their Majesties the King and Queen of the Belgians; Brussels.*

ELECTED

1825 Harry Carter, M.D., *Physician to the Kent and Canterbury Hospital; Canterbury.*

1818 Richard Cartwright, 34, *Bloomsbury-square.*

1820 Samuel Cartwright, F.R.S., *Nizell's-house, near Tonbridge.*

1845 Samuel Cartwright, Jun., *Sackville-street, Piccadilly.*

1839 William Cathrow, *Weymouth-street.*

1845 William Oliver Chalk, *Nottingham-terrace, New-road.*

1818 Richard Chamberlaine, *Kingston, Jamaica.*

1816 William Frederick Chambers, K.C.H., M.D., F.R.S., *Physician to the Queen, and to the Queen Dowager;* 46, *Brook-street.* C. 1818. V.P. 1821. P. 1845.

1844 Thomas King Chambers, M.D., 1, *Hill-street, Berkeley-square.*

1837 Henry T. Chapman, 16, *Lower Seymour-street, Portman-square.*

1838 George Chaplin Child, M.D., *Physician to the Westminster General Dispensary;* 12, *Queen Anne-street, Cavendish-square.*

1842 W. D. Chowne, M.D., *Physician to the Charing-cross Hospital;* 8, *Connaught-place West, Hyde-park.*

1827 Sir James Clark, Bart, M.D., F.R.S., *Physician to the Queen, Physician in Ordinary to His Royal Highness Prince Albert, and Consulting Physician to their Majesties the King and Queen of the Belgians; Brook-street.* C. 1830. V.P. 1832.

1839 Frederick Le Gros Clark, SECRETARY; *Assistant-Surgeon to, and Lecturer on Descriptive and Surgical Anatomy at, St. Thomas's Hospital;* 24, *Spring-gardens.* S. 1847.

1845 John Clark, M.D., *Staff Surgeon 2nd class;* 12, *Beaumont-street, Portland-place.*

1847 Benjamin Clark, *Brook-street, Grosvenor-square.*

1848 John Clarke, *Surgeon to the Brownlow-street Hospital;* 3, *Clifford-street, Bond-street.*

1835 James Clayton, 3, *Percy-street, Bedford-square.*

1842 Oscar M. P. Clayton, 3, *Percy-street, Bedford-square.*

1827 John Clendinning, M.D., F.R.S., *Physician to the St. Marylebone Infirmary;* 16, *Wimpole-street.* C. 1832. S. 1834. V.P. 1840.

1835 *William Colborne, *Chippenham, Wilts.*

1818 Robert Cole, F.L.S., *Holybourne, Hampshire.*

1847 James Milman Coley, M.D., 47, *Chester-square.*

ELECTED

1828 John Conolly, M.D., *Hanwell.*

1839 John C. Cooke, M.D., 2, *Whitefriars-street, Fleet-street.*

1840 *William Robert Cooke, *Burford, Oxfordshire.*

1840 Bransby Blake Cooper, F.R.S., *Surgeon to, and Lecturer on Surgery at, Guy's Hospital; New-street, Spring-gardens.* C. 1830. V.P. 1842.

1820 Benjamin Cooper, *Stamford.*

1819 George Cooper, *Brentford.*

1841 George Lewis Cooper, *Surgeon to the Bloomsbury Dispensary,* 35, *Keppel-street, Russell-square.*

1843 William White Cooper, *Senior Surgeon to the North London Ophthalmic Institution, and to the Honourable Artillery Company;* 2, *Tenterden-street, Hanover-square.*

1841 Holmes Coote, *Demonstrator of Anatomy at St. Bartholomew's Hospital, Surgeon to the North London Ophthalmic Institution;* 14, *Southampton-street, Bloomsbury.*

1835 George F. Copeland, *Cheltenham.*

1822 James Copland, M.D., F.R.S., *Consulting Physician to Queen Charlotte's Lying-in Hospital;* 5, *Old Burlington-street.* C. 1830. V.P. 1838.

1847 John Rose Cormack, M.D., *Putney, Surrey.*

1839 *Charles C. Corsellis, M.D., *Resident Physician to the Lunatic Asylum, Wakefield.*

1814 *William Cother, *Surgeon to the Infirmary, Gloucester.*

1847 Richard Payne Cotton, M.D., *Assistant-Physician to the Hospital for Consumption and Diseases of the Chest;* 4, *Bolton-street, Piccadilly.*

1828 William Coulson, *Surgeon to the Magdalen Hospital, Consulting Surgeon to the City Lying-in Hospital; Frederick's-place, Old Jewry.* C. 1831. L. 1832.

1817 Sir Philip Crampton, Bart, F.R.S., *Surgeon-General to the Forces in Ireland.*

1841 M. A. N. Crawford, M.D., *Physician to, and Lecturer on Medicine at, the Middlesex Hospital;* 62, *Upper Berkeley-street, Portman-square.*

1822 Sir Alexander Crichton, M.D., F.R.S., and F.L.S., *Physician in Ordinary to their Imperial Majesties the Emperor and Dowager Empress of all the Russias.* C. 1823.

1847 George Critchett, *Assistant-Surgeon to the London Hospital, and the Royal London Ophthalmic Hospital; Finsbury-square.*

ELECTED

1837 John Farrar Crookes, 53, *Russell-square.*

1820 John Green Crosse, M.D., F.R.S., *Surgeon to the Norfolk and Norwich Hospital.*

1812 *Henchman Crowfoot, *Beccles.*

1818 William Cuming, M.D., *Professor of Botany at the Glasgow Institution, and Surgeon to the Royal Infirmary at Glasgow.*

1837 Thomas Blizard Curling, *Lecturer on Surgery at, and Assistant-Surgeon to, the London Hospital;* 37, *New Broad-street.* S. 1845.

1846 Henry Curling, *Ramsgate.*

1847 J. Edmund Currey, *Surgeon to the Blenheim-street Free Dispensary;* 16, *Pall-mall.*

1836 George Cursham, M.D., *Physician to the Hospital for Consumption and Diseases of the Chest, and to the Female Orphan Asylum;* 5, *Saville-row.* S. 1842.

1847 Henry Charles Curtis, *Great Marlow, Bucks.*

1822 Christopher John Cusack.

1828 Adolphe Dalmas, M.D., *Paris.*

1840 John Dalrymple, *Surgeon to the London Ophthalmic Hospital;* 56, *Grosvenor-street.* C. 1848.

1836 *James S. Daniel, *Ramsgate.*

1820 George Darling, M.D., 6, *Russell-square.* C. 1841.

1818 *Sir Francis Sacheverel Darwin, Knt., M.D.; *Breadsall Priory, near Derby.*

1818 Henry Davies, M.D., VICE-PRESIDENT; *Physician to the British Lying-in Hospital, Brownlow-street; Physician-Accoucheur to the Marylebone General Dispensary; Saville-row.* C. 1827.

1846 Frederick Davies, 19, *Upper Gower-street, Bedford-square.*

1847 John Davies, M.D., *Physician to the Hertford Infirmary, and Visiting Physician to the County Gaol and Lunatic Asylum, Hertford.*

1820 Thomas Davis, *Brook-street, Hanover-square.* C. 1843.

1818 James Dawson, *Liverpool.*

1841 Campbell De Morgan, *Surgeon to, and Lecturer on Anatomy at, the Middlesex Hospital;* 17, *Manchester-street.*

1846 *Samuel Best Denton, *Ivy-lodge, Hornsea, East Riding, Yorkshire.*

1847 George E. Day, M.D., 27, *Upper Seymour-street, Portman-square.*

1816 *Sir David James Hamilton Dixon, M.D., F.R.S. ED., and

ELECTED

F.L.S., *Physician to the Fleet, and to the Royal Naval Hospital, Plymouth.*

1839 James Dixon, *Assistant-Surgeon to St. Thomas's Hospital, and Surgeon to the Royal London Ophthalmic Hospital;* 37, *Broad-street-buildings.*

1844 Robert Dickson, M.D., 16, *Hertford-street, May-fair.*

1845 John Dodd, 1, *Bryanston-street, Portman-square.*

1826 John Sommers Down, M.D., *Southampton.*

1839 Henry Pye Lewis Drew, 79, *Gower-street, Bedford-square.*

1846 John Drummond, *Deputy Inspector of Fleets and Hospitals; Royal Naval Hospital, Woolwich.*

1843 Thomas Jones Drury, M.D., *Physician to the Salop Infirmary; Shrewsbury.*

1845 George Duff, M.D., *Genoa.*

1845 Edward Duffin, *Langham-place, Portland-place.*

1833 Robert Dunn, *Norfolk-street, Strand.* C. 1845.

1843 C. M. Durrant, M.D., *Physician to the East Suffolk and Ipswich Hospital; Ipswich.*

1839 Henry Dyer, M.D., 37, *Bryanston-square.*

1836 J. W. Earle, *Cheltenham.*

1824 George Edwards.

1823 C. C. Egerton, *India.*

1838 Thomas Elliotson, M.D., *Clapham.*

1835 William England, M.D., *Wisbeach.*

1842 John E. Erichsen, *Assistant-Surgeon to University College Hospital, and Surgeon to the City of London Hospital for Diseases of the Chest, &c.;* 48, *Welbeck-street, Cavendish-square.*

1815 G. F. D. Evans, M.D., *Hill-street, Berkeley-square.* C. 1838.

1836 George F. Evans, M.B., *Physician to the Birmingham Hospital.*

1845 William Julian Evans, M.D.

1841 Sir James Eyre, M.D., *Physician-Accoucheur to St. George's and St. James's Dispensary;* 11, *Brook-street, Grosvenor-square.*

1844 Arthur Farre, M.D., F.R.S., *Professor of Midwifery in King's College, London; Curzon-street, May-fair.*

1831 Robert Ferguson, M.D., *Physician-Accoucheur to the Queen. Physician to the Westminster Lying-in Hospital;* 125, *Park-street, Grosvenor-square.* C. 1839. V. P. 1847.

ELECTED

1841 William Fergusson, F.R.S. Ed., *Professor of Surgery in King's College, London; and Surgeon to King's College Hospital; George-street, Hanover-square.*

1836 John W. Fisher, *Surgeon in Chief to the Metropolitan Police Force; 7, Upper Grosvenor-street.* C. 1843.

1839 George Lionel Fitzmaurice, 97, *Gloucester-place, Portman-square.*

1842 Thomas Bell Elcock Fletcher, M.D., *Physician to the General Dispensary, Birmingham.*

1841 John Forbes, M.D., F.R.S., *Physician to Her Majesty's Household; 12, Old Burlington-street.*

1817 *Robert T. Forster, *Southwell.*

1820 Thomas Forster, M.D., *Hartfield-lodge, East Grinsted.*

1846 Algernon Frampton, M.D , *Physician to the London Hospital; New Broad-street.*

1816 John W. Francis, M.D., *Professor of Materia Medica in the University of New York.*

1841 J. Ch. August. Franz, M.D., *Royal German Spa, Brighton.*

1843 Patrick Fraser, M.D., *Assistant-Physician to the London Hospital; Guildford-street, Russell-square.*

1846 Joseph Freeman, 21, *Spring-gardens.*

1836 John G. French, *Surgeon to St. James's Infirmary*; 41, *Great Marlborough-street.*

1846 Henry William Fuller, M.B., *Assistant-Physician to, and Lecturer on Medical Jurisprudence at, St. George's Hospital; 45, Half Moon-street, Piccadilly.*

1815 *George Frederick Furnival, *Egham.*

1848 John Gay, *Surgeon to the Royal Free Hospital; 10, Finsbury-place, Finsbury-square.*

1819 John Samuel Gaskoin, 32, *Clarges-street.* C. 1836.

1819 Henry Gaulter.

1821 *Richard Francis George, *Surgeon to the Bath Hospital.*

1841 J. Durancè George, F.G.S., *Lecturer on Dental Surgery at University College, and Dental Surgeon to University College Hospital; 32, Old Burlington-street.*

1812 George Goldie, M.D., *York.*

1837 Richard H. Goolden, M.D., *Assistant-Physician to St. Thomas's Hospital; 41, Sussex-gardens, Hyde-park.*

1818 James Alexander Gordon, M.D., F.R.S. C. 1828. V. P. 1829.

1844 John Grantham, *Crayford, Kent.*

ELECTED

1846 George Thompson Gream, *Surgeon to Queen Charlotte's Lying-in Hospital*; 42, *Hertford-street, May-fair.*

1816 Joseph Henry Green, F.R.S., *Surgeon to St. Thomas's Hospital; Hadley, Middlesex.* C. 1820. V.P. 1830.

1841 George Gregory, M.D., *Physician to the Small-pox Hospital*; 31, *Weymouth-street.* S. 1825.

1843 Robert Greenhalgh, *Upper Charlotte-street, Fitzroy-square.*

1814 John Grove, M.D., *Salisbury.*

1837 James Manby Gully, M.D., *Holyrood-house, Great Malvern.*

1819 John Gunning, *Inspector of Hospitals; Paris.*

1841 Charles Guthrie, *Assistant-Surgeon to the Westminster Ophthalmic Hospital; Albemarle-street.*

1827 Marshall Hall, M.D., F.R.S., *Manchester-square.* L. 1828. C. 1840. V.P. 1843.

1842 *George Hall, M.D., 14, *Old Steine, Brighton.*

1845 John Hall, M.D., *Deputy Inspector-General of Hospitals; Cape of Good Hope.*

1848 Alexander Halley, M.D., *Queen Anne-street, Cavendish-square.*

1819 Thomas Hammerton, 111, *Piccadilly.* C. 1829.

1838 Henry Hancock, *Surgeon to the Charing-cross Hospital; Harley-street.*

1848 *George Harcourt, M.D., *Chertsey, Surrey.*

1836 J. F. Harding, 6, *Mylne-street, Myddelton-square.*

1843 Thomas Sunderland Harrison, M.D., F.L.S., *Garston-lodge, Somersetshire.*

1846 John Harrison, *The Court-yard, Albany.*

1841 William Harvey, *Surgeon to the Royal Dispensary for Diseases of the Ear, and to the Freemasons' Female Charity*; 2, *Soho-square.*

1845 John Havers, *Bedford-place, Russell-square.*

1816 *John Haviland, M.D., *Regius Professor of Physic in the University of Cambridge; Physician to Addenbrooke's Hospital; Cambridge.*

1828 Cæsar H. Hawkins, *Surgeon to St. George's Hospital*; 26, *Lower Grosvenor-street.* C. 1830. V.P. 1838. T. 1841.

1838 Charles Hawkins, 22, *Saville-row.* C. 1846.

1820 Thomas Emerson Headlam, M.D., *Newcastle-upon-Tyne.*

1848 James Newton Heale, M.D., 11, *Westbourne-crescent, Hyde-park.*

1829 Thomas Heberden, M.D., 11, *Upper Brook-street.*

ELECTED

1844 John Hennen, M.D., LIBRARIAN; *Physician to the Western General Dispensary;* 24, *Upper Southwick-street, Hyde-park.*

1821 Vincent Herberski, M.D., *Professor of Medicine in the University of Wilna.*

1843 Prescott Gardner Hewett, *Assistant-Surgeon to St. George's Hospital; Lecturer on Anatomy at St. George's Hospital Medical School;* 35, *Hertford-street, May-fair.*

1841 *Nathaniel Highmore, *Consulting-Surgeon to the Weymouth and Dorsetshire Eye Infirmary; Sherborne.*

1814 *William Hill, *Wooton-under-Edge.*

1842 William Augustus Hillman, *Surgeon to the Farringdon Dispensary; Argyll-street.*

1841 John Hilton, F.R.S., *Assistant-Surgeon to, and Lecturer on Anatomy at, Guy's Hospital;* 10, *New Broad-street.*

1848 Martin Thomas Hiscox, M.D., *Bath, Somerset.*

1840 Thomas Hodgkin, M.D., 9, *Brook-street.* C. 1842.

1813 Joseph Hodgson, F.R.S., *Surgeon to the General Hospital, and to the Eye Infirmary, Birmingham.* C. 1817.

1835 T. H. Holberton, *Surgeon Extraordinary to the Queen Dowager; Hampton.*

1843 Luther Holden, 39, *Ely-place, Holborn.*

1814 Henry Holland, M.D., F.R.S., *Physician Extraordinary to the Queen, and Physician in Ordinary to His Royal Highness Prince Albert;* 25, *Brook-street.* C. 1817. V.P. 1826.

1846 Bernard William Holt, *Assistant-Surgeon to the Westminster Hospital; Abingdon-street, Westminster.*

1846 Carsten Holthouse, *Surgeon to the Public Dispensary, Lincoln's Inn; Lecturer on Anatomy and Physiology;* 3, *Serle-street, Lincoln's-inn-fields.*

1819 *John Howell, M.D., F.R.S. ED.; *Clifton.*

1828 *Edward Howell, M.D., *Swansea.*

1844 Edwin Humby, *Windsor-terrace, Maida-hill.*

1822 Robert Hume, M.D., *Inspector of Hospitals; Commissioner in Lunacy;* 9, *Curzon-street.* V.P. 1836.

1840 Henry Hunt, M.D., *Brook-street, Hanover-square.*

1842 Christopher Hunter, *Downham, Norfolk.*

1820 William Hutchinson, M.D.

1840 Charles Hutton, M.D., *Physician to the Royal Infirmary for Children;* 25, *Motcomb-street, Belgrave-square.*

1848 George Cockburn Hyde, 5, *Montpelier-square, Brompton.*

ELECTED

1838 William Ifil, M.D.

1847 William Edmund Image, *Surgeon to the Suffolk General Hospital; Bury St. Edmund's.*

1826 William Ingram, *Midhurst.*

1839 A. R. Jackson, M.D., *East India Company's Depôt, Warley Barracks, Essex.*

1845 *Henry Jackson, *Surgeon to the Sheffield General Infirmary; St. James's-row, Sheffield.*

1841 Paul Jackson, *Thayer-street, Manchester-square.*

1847 Thomas Reynolds Jackson, 28, *Charles-street, St. James's.*

1841 Maximilian M. Jacobovicz, M.D., *Pesth.*

1825 John B. James, M.D.

1847 *William Withall James, *Exeter, Devon.*

1844 Samuel John Jeafferson, M.D., *Warwick.*

1839 Julius Jeffreys, F.R.S.

1840 *G. Samuel Jenks, M.D., *Brighton.*

1848 Athol Johnson, *Lecturer on Physiology and General Anatomy at St. George's Hospital;* 9, *Old Bond-street.*

1821 Edward Johnson, M.D., *Weymouth.*

1847 George Johnson, M.D., *Assistant-Physician to King's College Hospital: King's College, Strand.*

1837 Henry Charles Johnson, *Assistant-Surgeon to, and Lecturer on Medical Jurisprudence at, St. George's Hospital; Saville-row.*

1844 John Johnston, 16, *Dover-street, Piccadilly.*

1844 Henry Bence Jones, M A., F.R.S., *Physician to, and Lecturer on Chemistry at, St. George's Hospital; Lower Grosvenor-street.*

1835 H. D. Jones, 20, *Soho-square.*

1837 T. W. Jones, M.D., 19, *Finsbury-pavement, Finsbury-square.*

1829 *G. Julius, *Richmond.*

1816 *George Hermann Kauffman, M.D., *Hanover.*

1815 Robert Keate, *Serjeant-Surgeon to the Queen, Surgeon to the Queen Dowager, to H.R.H. the Duke of Cambridge, to H.R.H. the Duchess of Gloucester, and to St. George's Hospital;* 11, *Hertford-street, May-fair.* C. 1818. V.P. 1826.

1838 Lionel P. Kell, *Bridge-street, Westminster.*

1848 *Daniel Burton Kendell, M.D., 7, *St. John's, Wakefield, Yorkshire.*

1847 Alfred Keyser, *Norfolk-crescent, Oxford-square.*

ELECTED

1839 *David King, M.D., *Eltham.*

1836 P. Nugent Kingston, M.D., *Physician to, and Lecturer on Medicine at, the Westminster Hospital; Curzon-street, May-fair.* C. 1846.

1806 James Laird, M.D.

1840 Samuel Lane, *Assistant-Surgeon to the Lock Hospital, and Lecturer on Anatomy; Grosvenor-place.*

1841 *Charles Lashmar, M.D., *Croydon, Surrey.*

1816 G. E. Lawrence.

1809 William Lawrence, F.R.S., *Surgeon Extraordinary to the Queen; Surgeon to St. Bartholomew's Hospital, and to Bridewell and Bethlem Hospitals; Lecturer on Surgery at St. Bartholomew's Hospital;* 18, *Whitehall-place.* S. 1813. V.P. 1818. C. 1820. T. 1821. P. 1831.

1840 Thomas Laycock, M.D., *York.*

*Jesse Leach, *Heywood, near Bury, Lancashire.*

1823 John G. Leath, M.D.

1822 John Joseph Ledsam, *Surgeon to the Birmingham Eye Infirmary.*

1822 Robert Lee, M.D., F.R.S., *Physician to the British Lying-in Hospital, and Physician-Accoucheur to the St. Marylebone Infirmary; Lecturer on Midwifery at St. George's Hospital;* 4, *Saville-row.* C. 1829. S. 1830. V.P. 1835.

1823 Henry Lee, M.D., 20, *Keppel-street, Russell-square.* C. 1837. S. 1839.

1842 Edwin Lee.

1843 Henry Lee, *Assistant-Surgeon to King's College Hospital, and Assistant-Surgeon to the Lock Hospital;* 3, *Dover-street, Piccadilly.*

1846 Thomas Safford Lee, *Cambridge.*

1843 John Leeson, 4, *Finsbury-square.*

1836 Frederick Leighton, M.D.

1847 John C. W. Lever, M.D., *Physician-Accoucheur to Guy's Hospital; Wellington-street, Borough.*

1847 Sir John Liddell, M.D., F.R.S., *Inspector of Hospitals; Royal Hospital, Greenwich.*

1806 John Lind, M.D.

1845 William Little, M.D., *Physician to, and Lecturer on Medicine at, the London Hospital; Finsbury-square.*

1818 Robert Lloyd, M.D.

ELECTED

1824 Eusebius Arthur Lloyd, *Surgeon to St. Bartholomew's Hospital, and Surgeon to Christ's Hospital;* 14, *Bedford-row.* S. 1827. V. P. 1838. C. 1843.

1820 J. G. Locher, M.C.D., *Town Physician of Zurich.*

1824 Charles Locock, M.D., *First Physician-Accoucheur to the Queen; Physician Extraordinary to the Queen Dowager, and Consulting Physician to the General Lying-in Hospital; Hertford-street, May-fair.* C. 1826. V.P. 1841.

1846 Henry Thomas Lomax, *Stafford.*

1844 Edward Lonsdale, *Assistant-Surgeon to the Orthopædic Institution; Guildford-street, Russell-square.*

1836 Joseph S. Löwenfeld, M.D., *Berbice.*

1815 *Peter Luard, M.D.

1846 William Salmon Lucas, 2, *Dowgate-hill, City.*

1814 Sir James Macgrigor, Bart., K.T.S., M.D., LL.D., F.R.S. L. and Ed., *Director-General of the Medical Department of the Army;* 3, *Harley-street, Cavendish-square.* C. 1820. V.P. 1815.

1823 George Macilwain, *Consulting Surgeon to the Finsbury Dispensary; The Court-yard, Albany.* C. 1829.

1818 W. Mackenzie, *Surgeon to the Eye Infirmary, Glasgow.*

1822 Richard Mackintosh, M.D.

1847 Henry John McDougall, 24, *Henrietta-street, Cavendish-square.*

1846 William M'Ewen, M.D., *Surgeon to the Cheshire County Gaol, and House-Surgeon to the Chester General Infirmary; Newgate-street, Chester.*

1839 William Macintyre, M.D., *Harley-street.*

1848 Frederick Wm. Mackenzie, M.D., 11, *Chester-place, Hyde-park-square.*

1844 Daniel Maclachlan, M.D., *Physician to the Royal Hospital, Chelsea.*

1842 John Macnaught, M.D., *Bedford-street, Liverpool.*

1835 D. C. Macreight, M.D., *St. Hillier's, Jersey.*

1837 A. M. M'Whinnie, *Lecturer on Comparative Anatomy at St. Bartholomew's Hospital; Bridge-street, Blackfriars.*

1836 John Malyn.

1848 W. O. Markham, M.D., *Kensington-garden-terrace, Hyde-park.*

1824 Sir Henry Marsh, Bart., M.D., *Dublin.*

1838 Thomas Parr Marsh, M.D., *Physician to the Salop Infirmary, Shrewsbury.*

ELECTED

1840 John Marston, 6, *Devonshire-street, Portland-place.*

1841 James Ranald Martin, F.R.S., 71 A, *Grosvenor-street.*

1819 *John Masfen, *Surgeon to the County General Infirmary, and Fever Hospital, Stafford.*

1818 J. P. Maunoir, *Professor of Surgery at Geneva.*

1820 Herbert Mayo, F.R.S. S. 1825. V.P. 1834.

1837 Thomas Mayo, M.D., F.R.S., *Physician to the St. Marylebone Infirmary; Wimpole-street.* S. 1841. C. 1847.

1839 R. H. Meade, *Bradford, Yorkshire.*

1819 *Thomas Medhurst, *Hurstbourne Tarrant.*

1847 Edward Meryon, M.D., 14, *Clarges-street, Piccadilly.*

1837 S. W. J. Merriman, M.D., *Consulting Physician to the Westminster General Dispensary, and Assistant-Physician to the West London Lying-in Institution; Brook-street.*

1815 Augustus Meyer, M.D., *St. Petersburgh.*

1840 Richard Middlemore, *Surgeon to the Eye Infirmary, Birmingham.*

1847 James Miller, M.D., 40, *Welbeck-street, Cavendish-square.*

1818 *Patrick Miller, M.D., F.R.S. Ed., *Physician to the Devon and Exeter Hospitals, and to the Lunatic Asylum; Exeter.*

1848 Gavin Milroy, M.D., *Fitzroy-square.*

1844 Nathaniel Montefiore, 4, *Great Stanhope-street, Park-lane.*

1828 Joseph Moore, M.D., *Physician to the Royal Freemasons' Female Charity;* 10, *Saville-row.* C. 1837.

1836 George Moore, M.D., *Hastings.*

1842 Thomas Morton, *Surgeon to University College Hospital, and Surgeon to the Queen's Prison;* 7, *Woburn-place, Russell-square.*

1847 Simon Murchison, 16, *Chester-terrace, Chester-square.*

1814 *George Frederick Muhry, M.D., *Hanover.*

1841 Edward William Murphy, M.D., *Professor of Midwifery in University College; Henrietta-street, Cavendish-square.*

1845 Thomas D. Mütter, M.D., *Professor of Surgery in Jefferson Medical College; Philadelphia.*

1840 Robert Nairne, M.D., *Physician to, and Lecturer on Medicine at, St. George's Hospital;* 44, *Charles-street, Berkeley-square.* C. 1848.

1835 Thomas Andrew Nelson, M.D., 41, *George-street, Portman-square.*

1843 Edward Newton, *Howland-street, Fitzroy-square.*

1816 Thomas Nixon (*Army*).

ELECTED

1819 *George Norman, *Surgeon to the United Hospital and Puerperal Charity; Bath.*

1845 Henry Norris, *South Petherton, Somerset.*

1829 John North, *Gloucester-place.* C. 1835.

1847 *William E. C. Nourse, *Santry-house, Dublin.*

1843 William O'Connor, 21, *George-street, Portman-square.*

1847 Thomas O'Connor, *March, Cambridgeshire.*

1846 Francis Odling, *Devonshire-street, Portland-place.*

1822 James Adey Ogle, M.D., F.R.S., *Clinical and Aldrichian Professor of Medicine, Oxford; and Senior Physician to the Radcliffe Infirmary.*

1842 William Piers Ormerod, *Surgeon to the Radcliffe Infirmary, Oxford.*

1846 Edward Latham Ormerod, M.B., *Demonstrator of Morbid Anatomy at St. Bartholomew's Hospital;* 18, *New Burlington-street.*

1844 Drewry Ottley, *Bedford-place, Russell-square.*

1847 William Emanuel Page, M.D., *Physician to, and Lecturer on Medicine at, St. George's Hospital; Curzon-street, Mayfair.*

1847 *William Bousfield Page, *Surgeon to the Cumberland Infirmary; Carlisle.*

1840 James Paget, *Assistant-Surgeon to, and Lecturer on General and Morbid Anatomy and Physiology, and Warden of the Collegiate Establishment at, St. Bartholomew's Hospital.*

1806 *Robert Paley, M.D., *Bishopston-grange, near Ripon, Yorkshire.*

1836 J. W. Langston Parker, *Birmingham.*

1843 *Charles Lewis Parker, A.M., *Surgeon to the Radcliffe Infirmary, Oxford.*

1847 Nicholas Parker, M.B., *Microscopical Demonstrator of Morbid Anatomy at the London Hospital School of Medicine; Finsbury-square.*

1841 John Parkin, 23, *Pelham-place, Fulham-road.*

1828 Richard Partridge, F.R.S., VICE-PRESIDENT; *Surgeon to King's College Hospital, and Professor of Anatomy in King's College, London;* 17, *New-street, Spring-gardens.* S. 1832. C. 1837. V.P. 1847.

1819 Granville Sharp Pattison, *New York.*

1845 Thomas Bevill Peacock, M.D., *Physician to the Royal Free Hospital and Royal General Dispensary;* 20, *Finsbury-circus.*

ELECTED

1830 Charles P. Pelechin, M.D., *St. Petersburgh.*

1830 William Pennington, 21, *Montague-place, Russell-square.*

1819 John Pryor Peregrine, *Penzance, Cornwall.*

1839 Thomas Peregrine, 3, *Half-moon-street.*

1831 Jonathan Pereira, M.D., F.R.S., F.L.S., VICE-PRESIDENT; *Assistant-Physician to, and Lecturer on Materia Medica at, the London Hospital; Finsbury-square.* C. 1844. V.P. 1847.

1844 William V. Pettigrew, 7, *Chester-street, Grosvenor-place.*

1814 *Edward Phillips, M.D., *Physician to the County Hospital; Winchester.*

1837 Benjamin Phillips, F.R.S., TREASURER; *Surgeon to, and Lecturer on Surgery at, the Westminster Hospital;* 17, *Wimpole-street.* L. 1841. T. 1847.

1848 Edward Phillips, M.D., *Coventry.*

1846 Francis Richard Philp, M.D., *Physician to St. Luke's Hospital;* 28, *Grosvenor-street.*

1836 Isaac Pidduck, M.D., 22, *Montague-street, Russell-square.*

1841 Henry Pitman, M.D., *Assistant-Physician to, and Lecturer on Materia Medica at, St. George's Hospital; Montague-place, Russell-square.*

1845 George David Pollock, *Surgeon to the North London Ophthalmic Institution, and Lecturer on Anatomy at St. George's Hospital Medical School; Bruton-street, Berkeley-square.*

1843 Charles Pope, M.D., M.A., F.L.S., *Temple Cloud, near Bristol.*

1846 Jephson Potter, M.D., F.L.S., 13, *Oxford-road, Manchester.*

1840 Lewis Powell, *John-street, Berkeley-square.*

1842 James Powell, M.B., *Great Coram-street, Brunswick-square,*

1839 John Propert, *New Cavendish-street.*

1814 William Prout, M.D., F.R.S., *Sackville-street.* C. 1816. V.P. 1823.

1845 John Pyle, *Surgeon to the North London Ophthalmic Institution; Oxford-terrace, Hyde-park.*

1816 Sir William Pym, M.D., *Inspector of Hospitals.*

1830 Jones Quain, M.D., *Paris.*

1835 Richard Quain, F.R.S., LIBRARIAN; *Surgeon to University College Hospital, and Professor of Clinical Surgery and of Anatomy in University College; Keppel-street.* C. 1838. L. 1846.

1807 John Ramsey, M.D., *Physician to the Infirmary at Newcastle.*

ELECTED

1821 Henry Reeder, M.D., *Ridge House, Chipping, Sudbury.*

1835 G. Regnoli, *Professor of Surgery in the University of Pisa.*

1842 David Boswell Reid, M.D., *House of Commons.*

1846 James Reid, M.D., *Physician to the Infirmary of St. Giles's and Bloomsbury; General Lying-in Hospital, &c.;* 29, *Brook-street.*

1847 Samuel Richards, M.D., 39 A, *Bedford-square.*

1829 Sir John Richardson, M.D., F.R.S., *Surgeon to the Naval Hospital; Chatham.*

1843 Joseph Ridge, M.D., *Cavendish-square.*

1845 Benjamin Ridge, M.D., *Putney, Surrey.*

1821 Charles Julius Roberts, M.D., *Physician to the Adult Deaf and Dumb and Welsh Charity;* 31, *New Bridge-street.* C. 1827.

1829 *Archibald Robertson, M.D., F.R.S. L. and Ed., *Physician to the General Infirmary, Northampton.*

1843 George Robinson, M.D., 40, *Blackett-street, Newcastle-on-Tyne.*

1845 J. M. Edward Roche, M.D., 12, *Cumberland-street, Portman-square.*

1843 William Roden, M.D., M.A., F.L.S., *Kidderminster, Worcestershire.*

1835 George Hamilton Roe, M.D., *Physician to, and Lecturer on Medicine at, the Westminster Hospital;* 6, *Hanover-square.* C. 1841.

1836 Arnold Rogers, 296, *Regent-street.*

1846 William Rogers, M.D., *Mortimer-street, Cavendish-square.*

1819 Henry S. Roots, M.D., *Consulting-Physician to St. Thomas's Hospital;* 2, *Russell-square.* C. 1833. V.P. 1834.

1829 Sudlow Roots, *Great Ormond-street, Queen-square.*

1836 Richard Roscoe, M.D.

1835 *Caleb B. Rose, *Swaffham.*

1845 Henry Mortimer Rowdon, *Lecturer on Anatomy at the Middlesex Hospital School of Medicine;* 35, *Baker-street, Portman-square.*

1841 Richard Rowland, M.D., *Physician to the Bloomsbury Dispensary;* 9, *Woburn-place, Russell-square.*

1836 James Russell, *Birmingham.*

1845 James Russell, Jun., *Birmingham.*

1827 *Thomas Salter, F.L.S., *Poole.*

1844 *Thomas Bell Salter, M.D., F.L.S., *Ryde, Isle of Wight.*

ELECTED

1842 George Sampson, 12, *Chester-street, Belgrave-square.*

1847 William H. O. Sankey, *London Fever Hospital, St. Pancras.*

1845 Edwin Saunders, *Surgeon-Dentist to, and Lecturer on Diseases of the Teeth at, St. Thomas's Hospital;* 13, *George-street, Hanover-square.*

1834 Ludwig V. Sauvan, M.D., *Warsaw.*

1840 Augustin Sayer, M.D., 28, *Upper Seymour-street.*

1824 Edward J. Seymour, M.D., F.R.S., *Charles-street, Berkeley-square.* C. 1826. S. 1827. V.P. 1830.

1840 William Sharp, F.R.S., F.G.S., F.R.A.S., *late Senior Surgeon to the Bradford Infirmary; Rugby, Warwickshire.*

1837 William Sharpey, M.D., F.R.S. L. and Ed., *Professor of Anatomy and Physiology in University College, London; Gloucester-crescent, Regent's-park.*

1836 Alexander Shaw, *Surgeon to the Middlesex Hospital; Henrietta-street, Cavendish-square.* C. 1842. S. 1843.

1848 Edward James Shearman, M.D., *Rotherham, Yorkshire.*

1848 Edward Henry Sieveking, M.D., 59, *Brook-street, Grosvenor-square.*

1839 Thomas Silvester, M.D., *High-street, Clapham.*

1842 John Simon, F.R.S., *Lecturer on Pathology at St. Thomas's Hospital;* 3, *Lancaster-place, Strand.*

1821 Charles Skene, M.D., *Professor of Anatomy and Surgery; Marischal College, Aberdeen.*

1827 George Skene, *Bedford.*

1824 Frederick C. Skey, F.R.S., *Assistant-Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital; Surgeon to the Northern Dispensary; Grosvenor-street.* C. 1828. L. 1829. V.P. 1841.

1810 Noel Thomas Smith, M.D., *Newcastle.*

1822 Southwood Smith, M.D., *Physician to the Fever Hospital, and to the Eastern Dispensary;* 38, *Finsbury-square.* C. 1838.

1835 John Gregory Smith, *Harewood, Yorkshire.*

1838 Henry Smith, *Surgeon to the General Dispensary, Aldersgate-street;* 21, *Upper Seymour-street, Portman-square.*

1845 William Smith, 12, *Park-street, Bristol.*

1847 William Smith, M.D., *Weymouth, Dorsetshire.*

1843 Robert William Smith, A.M., M.D., M.R.I.A., *Lecturer on Surgery at the Richmond Hospital School of Medicine;*

ELECTED

*Surgeon to the Talbot General Dispensary and Island Bridge Lunatic Asylum*; 62, *Eccles-street, Dublin.*

1843 John Snow, M.D., *Frith-street, Soho-square.*

1819 *George Snowden, *Ramsgate.*

1816 *John Smith Soden, *Sunbury, Middlesex.*

1830 Samuel Solly, F.R.S., *Senior Assistant-Surgeon to St. Thomas's Hospital; Surgeon to the General Dispensary, Aldersgate-street*; 1, *St. Helen's-place.* L. 1838. C. 1845.

1844 Frederick R. Spackman, M.B., *Harpenden, St. Alban's.*

1834 James Spark, *Newcastle.*

1843 *Stephen Spranger, *Swatheling-house, Southampton.*

1838 George James Squibb, 6, *Orchard-street.*

1835 Richard A. Stafford, *Surgeon Extraordinary to His Royal Highness the Duke of Cambridge; Surgeon to the St. Marylebone Infirmary; Old Burlington-street.* C. 1840.

1815 Edward Stanley, F.R.S., *President of the Royal College of Surgeons, Surgeon to St. Bartholomew's Hospital*; 23 A, *Brook-street.* C. 1821. S. 1824. V.P. 1827. T. 1832. P. 1843.

1835 Leonard Stewart, M.D., *Keppel-street.*

1842 Alexander Patrick Stewart, M.D., *Physician to the St. Pancras Dispensary*; 74, *Grosvenor-street.*

1839 Thomas Stone, M.D., 34, *Tonbridge-place, Euston-square; and Wyke House, Brentford.*

1843 Robert Reeve Storks.

1844 John Soper Streeter, *Harpur-street, Red Lion-square.*

1827 William Stroud, M.D., 20, *Great Coram-street.* C. 1831.

1847 William Allen Sumner, *Abbey-road, St. John's Wood.*

1839 Alexander John Sutherland, M.D., F.R.S., *Physician to St. Luke's Hospital; Parliament-street.*

1842 James Syme, *Professor of Clinical Surgery in the University of Edinburgh; Charlotte-square, Edinburgh.*

1847 William Symonds, 24, *Blandford-square.*

1844 R. W. Tamplin, *Surgeon to the Orthopædic Institution, Great Queen-street, Lincoln's-inn-fields.*

1848 Thomas Hawkes Tanner, M.D., *Physician to the Farringdon Dispensary*; 10, *Charlotte-street, Bedford-square.*

1840 Thomas Tatum, *Surgeon to, and Lecturer on Surgery at, St. George's Hospital; George-street, Hanover-square.*

1835 J. C. Taunton, *Surgeon to the City of London Truss Society, and to the City Dispensary*; 48, *Hatton-garden.* C. 1840.

ELECTED

1845 *John Taylor, M.D., *Physician to the Infirmary, Huddersfield.*

1845 Thomas Taylor, *Vere-street, Cavendish-square.*

1817 Frederick Thackeray, M.D., *Physician to Addenbrooke's Hospital, Cambridge.*

1845 Evan Thomas, *Pwllheli, North Wales.*

1839 Seth Thompson, M.D., *Physician to, and Lecturer on Medicine at, the Middlesex Hospital;* 1, *Lower Seymour-street.*

1842 Theophilus Thompson, M.D., F.R.S., *Physician to the Northern Dispensary, and to the Hospital for Consumption and Diseases of the Chest;* 3, *Bedford-square.*

1835 Frederick Hale Thomson, *Surgeon to the Westminster Hospital; Berners-street.*

1819 John Thomson, M.D., F.L.S., *Physician to the Finsbury Dispensary;* 1, *Pullin's-place, High-street, Islington.* C. 1833. L. 1834.

1836 John Thurnam, M.D., *The Retreat, York.*

1848 Edward John Tilt, M.D., *Physician to the Farringdon Dispensary;* 42, *Gloucester-road, Hyde-park-gardens.*

1834 Robert Bentley Todd, M.D., F.R.S., *Physician to King's College Hospital, Professor of Physiology and of General and Morbid Anatomy in King's College; New-street, Spring-gardens.* L. 1842.

1828 James Torrie, M.D., *Aberdeen.*

1843 Joseph Toynbee, F.R.S., *Surgeon to the St. George's and St. James's Dispensary; Argyll-place, Regent-street.*

1808 Benjamin Travers, F.R.S., *Surgeon Extraordinary to the Queen; Surgeon in Ordinary to His Royal Highness Prince Albert;* 12, *Bruton-street.* C. 1810. V.P. 1817. P. 1827.

1821 *William Travers, M.D., *Scarborough.*

1841 Matthew Truman, M.D., 44, *Gloucester-place, Kentish-town.*

1835 John Cusson Turner, M.D., *Brighton.*

1845 Thomas Turner, *Surgeon to the Royal Manchester Infirmary, and Lecturer on Anatomy; Mosley-street, Manchester.*

1819 Barnard Van Oven, *Consulting Surgeon to the Charity for Delivering Jewish Lying-in Women;* 30, *Gower-street, Bedford-square.*

1845 R. A. Varicas.

1806 Bowyer Vaux, *Surgeon to the General Hospital, Birmingham.*

1839 W. R. Vickers, 32, *Baker-street.*

ELECTED

1814 John P. Vincent, 16, *Lincoln's-inn-fields.* C. 1823. V. P. 1837.

1810 James Vose, M.D.

1846 Alexander Ure, *Surgeon to the Westminster General Dispensary;* 24, *Bloomsbury-square.*

1828 Benedetto Vulpes, M.D., *Physician to the Hospital of Aversa, and to the Hospital of Incurables, Naples.*

1841 Robert Wade, *Surgeon to the Westminster General Dispensary;* 68, *Dean-street.*

1823 William Wagner, M.D., *Berlin.*

1820 Thomas Walker, M.D., *Physician to the Forces, and to the Embassy at St. Petersburgh.*

1821 Tilleard Ward.

1845 T. Ogier Ward, M.D., *Leonard-place, Kensington.*

1846 Nathaniel Ward, *Demonstrator of Anatomy at the London Hospital;* 17, *Finsbury-place South.*

1814 Martin Ware, 51, *Russell-square.* C. 1844. T. 1846.

1811 John Ware.

1846 James Thomas Ware, *Surgeon to the Finsbury Dispensary;* 51, *Russell-square.*

1816 *Charles Bruce Warner, *Cirencester.*

1829 E. T. Warry, *Lyndhurst.*

1837 Thomas Watson, M.D., *Henrietta-street, Cavendish-square.* C. 1840. V.P. 1845.

1847 *Thomas Watson, *Holbeach, Lincolnshire.*

1842 Frederick Weber, M.D., *Physician to the St. George's and St. James's Dispensary; Norfolk-street, Park-lane.*

1844 William Wegg, M.D., *Physician to the Westminster General Dispensary;* 5, *Maddox-street, Hanover-square.*

1842 Charles West, M.D., *Lecturer on Midwifery at St. Bartholomew's Hospital; Physician-Accoucheur to the Middlesex Hospital, and Senior Physician to the Royal Infirmary for Children;* 96, *Wimpole-street, Cavendish-square.*

1841 Thomas West, M.D., F.L.S., *Daventry.*

1840 William Woodham Webb, *Gislingham, near Thwaite, Suffolk.*

1835 John Webster, M.D., F.R.S., *Consulting Physician to the St. George's and St. James's Dispensary;* 24, *Brook-street.* C. 1843.

1816 Sir Augustus West, *Deputy-Inspector of Hospitals to the Portuguese Forces; Lisbon.*

1828 John Whatley, M.D.

ELECTED

1840 Joseph Wickenden, *Birmingham.*

1824 *William Wickham, *Surgeon to the Winchester Hospital.*

1844 Frederick Wildbore, *High-street, Shoreditch.*

1837 G. A. F. Wilks, M.D., *Temple-walk, Matlock, Derbyshire.*

1840 C. J. B. Williams, M.D., F.R.S., *Professor of Medicine in University College, and Physician to University College Hospital; Holles-street.*

1829 Robert Willis, M.D., *Barnes.* L. 1838.

1831 *W. J. Wilson, *Surgeon to the Manchester Infirmary.*

1839 Erasmus Wilson, F.R.S., *Consulting Surgeon to the St. Pancras Infirmary; Charlotte-street, Fitzroy-square.*

1839 James Arthur Wilson, M.D., *Physician to St. George's Hospital; Dover-street.* C. 1846.

1825 Thomas A. Wise, *India.*

1841 George Leighton Wood, *Surgeon to the Bath Hospital; Queen-square, Bath.*

1848 William Wood, *Resident Medical Officer, Bethlem Hospital.*

1843 John Ward Woodfall, M.D., *Physician to the Western Dispensary;* 33, *Davies-street, Berkeley-square.*

1847 Robert Woollaston, *Conduit-street, Westbourne-terrace.*

1833 Thomas Wormald, *Assistant-Surgeon to St. Bartholomew's Hospital; Bedford-row.* C. 1839.

1842 W. C. Worthington, *Surgeon to the Infirmary, Lowestoft, Suffolk.*

1848 Edward John Wright, *Kennington-row, Kennington.*

1835 John Wright, M.D., *Prince's-court, Westminster.*

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[It is particularly requested that any change of Title or Residence may be communicated to the Secretaries before the 1st August in each year, in order that the List may be made as correct as possible.]

# HONORARY FELLOWS.

ELECTED

1841 William Thomas Brande, F.R.S. L. and Ed., *Professor of Chemistry at the Royal Institution of Great Britain; Royal Mint, Tower-hill.*

1835 Sir David Brewster, K.H., LL.D., F.R.S. L. and Ed., &c., *Cor. Mem. Roy. Institute of France, &c.; Kingussie.*

1841 Robert Brown, D.C.L., F.R.S., *Vice-President of the Linnean Society; British Museum.*

1835 The Very Rev. William Buckland, D.D., F.R.S., *Dean of Westminster.*

1847 Edwin Chadwick, *Barrister-at-law.*

1835 William Clift, F.R.S., *Royal College of Surgeons.*

1835 Michael Faraday, D.C.L., F.R.S., *Royal Institution.*

1841 Sir John Frederick William Herschel, Bart., D.C.L., F.R.S., *President of the Royal Astronomical Society; Somerset House.*

1835 Sir William J. Hooker, LL.D., F.R.S. L. and Ed., *Royal Botanic Garden, Kew.*

1847 Richard Owen, F.R.S., *Hunterian Professor to, and Curator of the Museum of, the Royal College of Surgeons of England.*

1835 The Rev. A. Sedgwick, A.M., F.R.S., &c., *Woodwardian Lecturer, Cambridge.*

1841 The Rev. William Whewell, D.D., F.R.S., *Master of Trinity College, Cambridge.*

# FOREIGN HONORARY FELLOWS.

ELECTED

1841 G. Andral, M.D., *Professor in the Faculty of Medicine; Paris.*

1815 Paolo Asalini, M.D., *Professor of Surgery, and Chief Surgeon to the Military Hospital at Milan, &c.*

1835 Carl Johan Eckström, K.P.S. and W., *Physician to the King of Sweden, First Surgeon to the Seraphim Hospital, Stockholm.*

1835 W. J. Edwards, M.D., F.R.S., *Member of the Institute of France; Paris.*

1841 Christian Gottfried Ehrenberg, *Berlin.*

1835 Baron A. de Humboldt, *Member of the Institute of France, &c.; Berlin.*

1841 James Jackson, M.D., *Professor of Medicine in the University of Cambridge, Boston, U.S.*

1843 Baron Justus Liebig, M.D., F.R.S., *Professor of Chemistry in the University of Giessen, &c.*

1841 P. C. A. Louis, M.D., *Physician to the Hôtel Dieu, Member of the Royal Academy of Medicine, &c.; Paris.*

1841 F. Magendie, M.D., *Member of the Institute; Physician to the Hospital of the Salpetrière; Paris.*

1847 Professor Matteucci, *University of Pisa.*

1841 Johann Müller, M.D., *Professor of Anatomy and Physiology, and Director of the Royal Anatomical Museum; Berlin.*

1835 J. C. Oersted, M.D., *Professor of Physics in the University of Copenhagen, &c., &c.*

1835 Professor Orfila, *Dean of Faculty, &c., &c.; Paris.*

1841 Bartolomeo Panizza, M.D., *Pavia.*

1843 Philibert Joseph Roux, *Member of the French Institute; Surgeon in Chief of the Hôtel Dieu; Professor in the Faculty of Medicine; Paris.*

1835 C. J. Timminck, *Director of the Museum of Natural History of the King of Holland; Amsterdam.*

1835 Friederich Tiedemann, M.D., *Professor of Anatomy and Physiology; Heidelberg.*

1841 John C. Warren, M.D., *Professor of Anatomy and Surgery in the University of Cambridge, Boston, U.S.*

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## ADVERTISEMENT.

THE Council of the Royal Medical and Chirurgical Society deems it proper to state that the Society does not hold itself in any way responsible for the statements, reasoning, or opinions, set forth in the various papers which, on grounds of general merit, are thought worthy of being published in its Transactions.

OBSERVATIONS

ON

# INTESTINAL OBSTRUCTIONS,

## DEPENDING ON INTERNAL CAUSES;

AND ON

## THE MEANS TO BE EMPLOYED FOR THEIR RELIEF.

By BENJAMIN PHILLIPS, F.R.S.,

SURGEON TO WESTMINSTER HOSPITAL.

Received Aug. 3rd—Read Nov. 9th, 1847.

At this advanced period in the history of medicine, it might reasonably be supposed that a disease must be either very insignificant in its consequences, or of very uncommon occurrence, if it have escaped very ample, and it may be sufficient, consideration; and no doubt the expectation would be usually realized. But there are diseases which are neither uncommon nor insignificant, and yet their history remains to be told: and of the number are obstructions of the bowels dependent on internal mechanical causes.

It is true that these affections have not entirely escaped notice; but since the Memoir of Hevin, confessedly very imperfect, no full consideration of the subject has been attempted, except in the Theses of Manoury and Bonnet, which are little known; and in our own country no author has devoted himself to the elucidation of the difficulties presented in the diagnosis and treatment of these diseases.

The personal experience of any man, however ample may have been his opportunities of observation, scarcely enables

him to comprehend fully the whole subject; but the records of cases are now sufficiently extensive to justify me in endeavouring to place the question of diagnosis and of treatment upon some clearer basis than they at present possess; and I trust the Society will feel that, in this attempt, I shall not be making an improper use of its time or its patience.

For the purpose of fairly considering these affections, it is necessary that I should clearly state, *First*, what I mean by intestinal obstructions dependent upon internal causes; *Second*, I must inquire whether the symptoms by which they are characterized are so clearly marked as to make the diagnosis satisfactory; *Third*, I must ascertain whether we can rely on ordinary means of treatment for their relief; and if not, whether we are justified in having recourse to surgical operations, performed with a view either to remove the obstacle or to establish an artificial anus.

To discuss these questions properly, I have collected the histories of 169 cases of obstruction.

Of these I found 136 on record; the remaining thirty-three are unpublished, but have been communicated to me by my friends, among whom I must particularise Dr. Hodgkin, or were observed by myself.

The amount of materials so collected is all I possess for the purposes of deducing rules of conduct in these cases, and I think it is enough; and if the results are, in my hands, inconclusive, it will be owing either to the nature of the subject, or to my want of ability to make the necessary deductions from them; and not to any want of materials for the purpose.

I comprehend under the term intestinal obstructions, all mechanical obstacles situated within the abdominal cavity, which, by their action upon the intestinal tube, intercept the course of fæcal matter.

They may be caused by an accumulation of matter within the canal, which may act by choking up the tube, (the matter may be hardened fæces, biliary or other concretions, or morbid growth,) by invagination, by twisting, or by a con-

traction of the intestine itself; in consequence of morbid action; by causes acting from without the tube, such as tumours making pressure, or bands constricting the intestine; or by the constriction exercised through the agency of the unyielding edges of an abnormal opening.

It will, of course, be observed that my definition excludes one class of cases in which obstruction may be complete, and the symptoms may, up to a certain point, resemble the cases of obstruction I propose particularly to consider—I mean cases of disease of the cæcal appendix. Usually, however, these cases admit of a more certain diagnosis. There may be equally obstinate constipation, fæcal vomiting, anxious countenance, and abdominal pain; but as there is usually quite sufficient indication to direct attention to the right iliac fossa, and to make the diagnosis pretty clear, I think these cases should be considered apart.

Such obstructions as I have selected for consideration are by no means of uncommon occurrence. I have endeavoured to estimate their frequency, by appealing to the experience of persons who have accurately noted not only these but all cases which have come under their observation; and I think it useful to give the results, although they may be only an approximation to the truth.

Out of 500 post-mortem inspections made by Louis, he discovered them only three times. Dr. Boyd out of 908 inspections, observed them eight times; Mr. Paget out of 224 cases, saw two instances; Mr. Prescott Hewett out of 760 cases, observed nine instances of obstruction. In all 2,392 cases, and twenty-two instances of obstruction. It would seem, therefore, that such obstructions are observed once out of every 100 post-mortem inspections.

Of the causes of obstruction which I have mentioned, it is difficult to say which occurs most frequently; but supposing recorded cases to represent fairly the relative frequency of each, then invagination, as compared with any other single cause, would occupy the first place.

Of the 169 cases which constitute the foundation of my

remarks, sixty-three were instances of invagination, sixteen were caused by the pressure of tumours from without, nineteen were the results of stricture from disease of the parietes, eleven were the result of intra-intestinal tumours, hardened fæces or concretions, and sixty were caused either by constriction, by bands, by adhesion, by the passage of the intestine through some abnormal opening, or by a twisting of the intestine upon itself.

The ordinary signs of intestinal obstructions are often, simply, constipation with more or less discomfort of the stomach and abdomen; and these symptoms may be quickly relieved. When the obstruction is more obstinate, these symptoms may be more severe; there may be vomiting, and the matter ejected may even become of a fæcal character, and in many instances relief, by ordinary means, may still be obtained, though with more difficulty. When the obstruction is caused by a mechanical and unyielding agent, the same train of symptoms may be manifested, and they become more severe in proportion to their duration. The countenance assumes an expression of anxiety, the heart's action is quickened, the breathing is more hurried, and there is great prostration and want of sleep, but the intellectual faculties are unimpaired. In the grouping of these symptoms there is, however, much variety.

Thus the *pain* may come on suddenly and with great violence, or there may have been occasional uneasiness or pain, with or without other signs, for months or even years. It may be diffused over much of the abdominal cavity, or it may be confined to a particular point, but at an advanced period of the disease the whole cavity usually becomes tender or painful. The pain is sometimes continuous, but there are usually paroxysms of more or less severity; still there may be no considerable abdominal pain through the whole progress of the disease up to the death of the patient, although that may be brought about within twenty-four hours. Instances of the kind are mentioned by Morgagni, by Fleury, by Spry, and others.

The *constipation* is usually complete; but there are some cases of invagination where small stools, containing an admixture of sanguineous mucus and fæcal matter, are passed, and tenesmus is sometimes present. The other cases of obstruction are rarely accompanied by any other stools than those which may be procured by washing out the large intestines.

*Vomiting* is not frequently absent in these cases; and it commonly proceeds until the vomited matter acquires a fæcal character; but I find that in several of the recorded cases, and in two instances which have come within my own observation, the sickness was not a distressing symptom, neither did it end in fæcal vomiting. In many instances it does not appear to have occasioned severe suffering.

The same may be said of the *abdominal tension*; it is usually great, and, to the patient, a very distressing symptom; but there are many cases of obstruction, from various causes, in which the abdomen was comparatively flat.

These signs may be observed, in all their completeness and intensity, in any case of intestinal obstruction, no matter how it is caused. But as it is desirable, as far as possible, to determine the cause of obstruction, because it may influence our plan of proceeding as to treatment, we must endeavour to ascertain whether the particular cause of obstruction is indicated by any particular modification of the symptoms I have described.

It seems to me, then, desirable to preface my description by a cursory detail of the more prominent symptoms which were presented in cases of the several varieties of obstruction which I have described, because they will illustrate the similarity of the symptoms produced, and the difficulty of establishing the differential diagnosis of the disease.

For the following interesting case of ileus, I am indebted to Dr. Todd.

Mr. I., a solicitor, aged 45, of temperate and active habits, was subject to constipated bowels, for which he was in the habit of taking an aloetic pill daily. On Wednesday evening, June 30, having some friends with him, he took a little brandy

and water (which always disagreed with him). On Thursday morning he awoke in a rigor, and with a feeling of uneasiness in the lower part of the abdomen, which soon became painful. He was bled from the arm, leeched on the abdomen, had fomentations, had calomel and opium, black draught, ol. ricini, &c., but without any relief. At three o'clock on the morning of the 2nd of July, Dr. Todd saw him, and found him in great agony; the abdomen was very tympanitic and extremely tender to the touch, sonorous on percussion on the epigastrium, but dull in the pubic and hypogastric regions: the voice was tremulous, the breathing was quick, and the face anxious. There had been no motion nor urine for twenty-four hours: no vomiting except once after a black draught. Pulse 120, feeble; the extremities were becoming cold; the intellect was clear. He was ordered to take opium largely, and nourishment. Six hours afterwards he died without any alteration in the symptoms.

*Post-mortem, July* 3.—The peritoneum was of a leaden colour with patches of redness: there was a small quantity of turbid serum in the pelvis; there were a few flakes of soft lymph on the small intestines. The last foot and a half of the small intestines was healthy, empty, and contracted. All the small intestines above that was very much dilated and filled with liquid fæces. The stomach was likewise much dilated and filled with liquid. The transition from the dilated to the contracted portion was abrupt and sudden, and there was no mark of external constriction or compression of any kind. The mucous membrane of the intestine was slightly red, but afforded no evidence of inflammation. The muscular coat had a dusky hue.

The *second* case I shall detail is one of obstruction by a biliary calculus; it occurred in the practice of Dr. Watson, and is thus described:—

"Very lately I attended an elderly lady who, from Wednesday morning to the next Monday noon, had had no alvine relief, notwithstanding the employment of the most active cathartics. 'She suffered frequent paroxysms of pain and vo-

miting, but the abdomen was scarcely, if at all, distended, nor was it tender. At length she complained that what she vomited was stercoraceous,—to use her own words, 'what came upwards ought to have passed the other way.' It was a thin, brown, ill-smelling fluid. Dr. Mayo and Mr. Arnott were now associated with me in this case, and they touched and felt the abdomen, as I had previously done. The lady observed that their hands were rather heavy, and she fancied the pressure they made had displaced something within. And I believe that it was so; for before our consultation in the next room was over, word was brought us that the bowels had acted. She had passed a liquid motion, precisely resembling the stuff she had last vomited. The next day, with one of several similar stools, a hard lump was voided, which proved to be a gall stone, as big as a walnut. It had probably been impacted higher up."

The *third* case was the result of the accumulation of fæcal matter, and is described by De la Martiniere.

A young man of 18 or 20 wishing to put an end to an obstinate diarrhœa, ate a quantity of hard eggs. Obstinate constipation followed, and resisted all remedies. The patient had all the symptoms of volvulus,—sickness, constipation, abdominal pain, and tension. He was bled, and purgatives of various kinds were administered, but without effect; the urgency of the symptoms increased, and the vomited matter became fæcal. Quicksilver was administered. The fæcal vomiting persisted, and he died some days afterwards. The intestines were prodigiously distended between the stomach and a column of hardened fæces which was impacted in the jejunum.

The *fourth* is a case of obstruction caused by intra-intestinal tumour; it occurred to Mr. Allen, from whose notes it is transcribed.

A. R., aged 38, was seen Feb. 3: she complained of pain in the region of the stomach, with constipation. He ordered her to take hyd. chlor. c. opio, to be followed by castor oil. The next day she was much worse; the bowels had not acted;

there was vomiting of a green fetid matter, and pain on pressure. Ordered that fifteen leeches should be applied upon the abdomen. Calomel and opium every six hours, to be followed by enemas.

5th.—Vomiting continues; constipation and tenderness persist. Pulse 90. Ordered to have more leeches, hydrocyanic acid, &c.

6th.—The pain is more intense and in paroxysms; she is much troubled with flatus. Ordered VS. ad ʒxij.

7th.—She has passed an easier night, and has not vomited since the last visit. In the evening the severe pain returned, and extended over the whole abdomen, and was followed by much fæcal vomiting. Ordered Rep. VS.

8th.—The vomiting continues; the strength is failing. Ordered ʒvj. brandy with beef-tea daily. The gums are spongy from mercury.

9th.—Fæcal vomiting continues. It persisted till the 20th; on that day the enema brought away a quantity of thin fæculent matter. The injections brought away more on the 21st and the 22nd; on the 23rd the bowels acted without assistance; the vomiting was less frequent, and she was much improved; but there was still occasional vomiting.

On the 9th of March, whilst sitting up in bed, she felt something give way in the abdomen, and died in fourteen hours.

Upon inspecting the abdomen, a large quantity of thin frothy fæcal matter was found in the cavity. A small rupture was found in the lower part of the jejunum; about sixteen inches of that intestine was in a gangrenous state. Below the rupture the intestine was occupied by a solid fibrous fleshy body about three inches in length. It was connected with the mucous coat by a very narrow neck. It had produced some invagination.

The *fifth* case was a malignant contraction of the colon.

H. C., aged 36, was Resident Medical Officer to the St. Marylebone Infirmary; he was subject to frequent irregularities in the functions of the intestines, and had been the

subject of fistula in ano. I was suddenly summoned to see him late one evening; he had a basin at his side, in which there was probably a pint of unequivocal fæcal matter, which he had vomited a few minutes before. He said, that after dinner he felt there was something wrong about the stomach; nausea came on, followed by vomiting. He first threw up the food he had taken at dinner, and, soon after, what there was in the basin.

Some nausea continued; the abdomen was tense and tender; and there had been complete obstruction for thirty-six hours. He took immediately hyd. chlor. gr. x. opii gr. j.; and it was ordered that an enema containing beef-tea and olive oil, of each half a pint, should be thrown up every four hours. In the course of the next day the bowels were copiously relieved. All the unpleasant symptoms quickly subsided, and he was apparently convalescent. On the evening of the second day, at night fall, he most imprudently walked out, and felt chilled. In the course of the night very urgent symptoms returned; the constipation was complete; the sickness was incessant; the abdomen was sore and tense. On this occasion all means failed, and he died. Upon examination, a malignant contraction was found at the angle formed by the transverse and descending colon; it barely allowed of the passage of a number eight bougie.

The *sixth* was a case of malignant tumour, pressing upon the colon from without the tube.

D. C., aged 73, suffered for some years from irregularity of the bowels. On the occasion of my seeing him, he had been constipated for forty-eight hours, and the usual means of relief had failed. There was much abdominal uneasiness and considerable tension, but no sickness. The ordinary cathartics were used by the mouth and the rectum, for thirty-six hours, without overcoming the constipation. The abdominal tension had become very great,—there was much distress of the stomach, with vomiting of fæcal matter, and hiccup. It was now determined to rely upon mercury externally and internally, and beef-tea injections. Calomel and opium were

given three times a-day, and mercurial ointment was rubbed over the abdomen morning and evening. Within thirty-six hours from the time of commencing this treatment, the bowels began to act, and within a fortnight he was able to leave town. In a few weeks he returned, and suffered a relapse. The same means were employed, but without effect: he died on the sixth day. The post-mortem inspection revealed the cause of mischief, a malignant tumour pressing upon the descending colon.

The *seventh* was a case of invagination.

A man aged 29, of delicate constitution, was brought into hospital suffering from acute pain in the abdomen, which was not increased by pressure; the abdominal muscles were contracted and rigid, there was no tension, nor appreciable tumour, the face was pale and anxious. The pulse was small but not frequent. There was nothing wrong about the head or the chest, and there was no hernia. He was attacked suddenly on the morning of that day with pain and vomiting. The sickness had abated during the day, but the pain continued. There was obstinate constipation. Sedatives were administered by the stomach and the rectum, and cataplasms were applied upon the abdomen. The pain increased and the vomiting returned, the abdominal tension became more distressing, the anxiety greater, the eyes sunken, the pulse more frequent. The symptoms became hourly more severe; on the fifth day the vomiting became fæcal, and on the tenth day he died. There was peritonitis, and invagination of the ilium in the cæcum and colon.

The *eighth* was a case of constriction by bands.

A man 36 years old was brought into the general hospital with the following symptoms: violent pain and tension of the abdomen, tenderness on pressure, thirst and vomiting, cold skin, small quick thready pulse. He attributed the attack to a cold caught by sitting on the grass. The symptoms abated under treatment, but on the fifth day they returned with violence, accompanied by obstinate constipation and fæcal vomiting. He died on the ninth day after admission.

Post-mortem inspection revealed extensive peritonitis. A membranous band, 2½ inches long and half an inch broad, extended from the anterior surface of the mesentery as a kind of loop: through it a portion of ilium passed and was strangulated. Above the strangulation the tube was distended and inflamed, below it was pale and contracted.

The following case is the *ninth*, and was caused by the passage of the intestine through an abnormal opening: it is stated more at length than the others, because the circumstances are sufficiently remarkable to warrant it.

On Saturday the 7th of May, I was requested to proceed immediately to the Court of Queen's Bench, to see a gentleman who was suddenly taken ill. I arrived there shortly after he had been carried into one of the upper rooms. I found him lying on the carpet doubled up, and suffering from most excruciating pains, occurring in paroxysms, and affecting principally the right side of the abdomen, but it was most severe under the liver and toward the umbilicus. He could bear firm pressure on the part without any aggravation of pain, rather a diminution.

The account he gave of himself was, that he had left home that morning quite well; that he was engaged up to past one o'clock in the duties of his office, sitting down with papers before him; that he was suddenly seized with the pain while thus occupied, and that it quickly acquired its greatest intensity; that it was at first accompanied by nausea, and that the bowels were at the same time slightly moved.

Taking into account the kind of pain, the suddenness of its occurrence, its seat, a yellowishness of the conjunctiva, the state of the pulse (52) and of the abdomen, and the fact that on several occasions pains similar in kind, though less severe, had occurred to him and disappeared within half an hour, I came to the conclusion that the pain was probably occasioned by the passage of a gall-stone, and that the best present remedy was a dose of opium; it was sent for and administered. I desired that if, in the course of half an hour, the pain was sufficiently abated, he should be conveyed home

and have a warm-bath; if not, that the opiate draught should be repeated.

At five o'clock I saw him at his own house. I found that the second draught had been necessary, and that the severity of the pain had greatly abated. Before six o'clock he was in the bath, and expressed himself as being greatly comforted by it. When taken out of the bath, all he complained of was a diffused soreness extending over the whole abdomen. The pulse was 54, and less laboured than when I first saw him; the complexion yellower.

At seven o'clock he took hydr. chlor. gr. xiij. opii gr. j. It was followed in three hours by the following draught: ol. ricini ʒvj. vitel. ovi q. s. tinct. sennæ co. ʒij. aq. menthæ q. s. ut fiat haustus.

At ten o'clock I saw him again; there was no material change in any respect; there had been slight sickness, three times within an hour soon after he had taken the pills, but there was no action upon the bowels; pulse 54.

At half-past seven o'clock on Sunday morning I saw him. The night had been free from violent pain, and there had been no sickness; there had been uneasiness, but not enough to prevent him from occasionally dosing. The soreness of the abdomen was somewhat increased, and there was a rigidity of the parietes; still he could bear, without complaint, firm pressure; the tongue was more coated than on the previous night, and the pulse was 106. I ordered a draught of tartrate of potash and infusion of senna, which was taken at eight o'clock.

At eleven o'clock there was no material change; no action upon the bowels, no sickness, but there was more tympanitis; pulse 120. A castor oil enema was administered; it was retained for half an hour, but it brought nothing away with it.

At three o'clock Dr. Watson saw him with me. There was no nausea; the tympanitis had increased; the abdomen was very tense; the tenderness on pressure was not considerable; the contour of a distended portion of intestine was distinctly evident on the right side; the pulse was

150, and weak; the tongue was coated, and the features were pinched.

The impression now was, that whatever had caused the intense initiatory pain, it was probable that there was at present some internal intestinal strangulation.

It was directed that he should have a large warm-water injection, fomentations to the abdomen, and in the event of pain increasing on the right side, that leeches should be applied:—besides those means, he was to take ext. coloc. co. gr. v. 4$^{tis}$ horis.

The warm-water injection was given, but he could not bear more than a pint, and it brought away nothing with it. The colocynth was taken, and it occasioned no nausea. A mustard poultice was laid upon the abdomen, and supported for an hour with comfort to the patient.

About five o'clock, instead of leeches it became necessary to administer brandy, the pulse having become weak, and failing; the stimulus was continued from that time, but he never rallied; and he died, without any change in the symptoms, about ten o'clock,—thirty-three hours from the occurrence of the first symptoms.

His mental faculties were preserved in all their integrity to the last. Five minutes before his death, a clergyman, who had been requested to attend for the purpose of administering the Sacrament to him, came to his bedside, when the patient observed that it was too late, and he immediately died without the slightest struggle.

It was clearly desirable, in this case, that a post-mortem examination should be had, and to it the friends made no objection. It was then arranged that it should be made on the next morning between eight and nine o'clock. When I went to the house for the purpose of proceeding with it, one of the friends suggested that it might be said we were too precipitate, that he was scarcely cold. With such an idea existing, I said it would be better to defer the inspection until the succeeding morning. This was done, and certainly we had cause to regret the delay. Although the death occurred only thirty-four hours before the examination was made, and

although only sixty hours before, he was apparently in good health, decomposition was greatly advanced.

The abdomen was enormously distended, the scrotum was as large as a child's head, the surface of the trunk was covered by very large vesicles containing a dark-coloured and very offensive fluid, and a good deal of dark bloody fluid had escaped from the mouth and nose. The cellular tissue was so distended with gas, that as soon as an incision was made through the skin, it escaped with a loud hissing noise.

When an opening was made into the abdominal cavity a good deal of dark fluid blood escaped, and probably six or eight ounces remained in the pelvic cavity. The intestines were so distended that they could not be kept within the abdomen. A portion of intestine on the right side, not thus distended, but gangrenous in appearance, left no doubt that there must be strangulation somewhere. Upon turning up the small intestines, it was at once evident that a portion of the ilium had passed through the right side of the mesentery. Careful observation was made at this point, and a very small opening was apparent, with an extremely dense margin; through this about eight inches of the ilium had passed and become strangulated. The opening was so small that the point of the little finger could not have been admitted if the intestine had been absent, and much difficulty was experienced in getting a common director to pass through it, by the side of the gut, and when there, several cuts with a sharp knife were necessary to liberate the intestine.

The state of the body made it prudent not to pursue the investigation any further, especially as the cause of death was so clearly made out.

The peculiarities of this case were, the sudden violence with which the attack commenced, the subsequent absence of those symptoms by which strangulation of intestines is commonly characterized, and the rapid termination of the disease in the death of the patient. On the day previous to the occurrence of the attack, the bowels had been copiously relieved by a five-grain pill composed of colocynth and blue pill.

The patient described himself as leaving home quite well on the morning of the attack, and walking down to Westminster Hall, where he continued discharging his official duties until the moment when his suffering commenced. Now did the severe pain mark the moment of the intestine passing through the mesentery, or did it mark the passage of a gall-stone? and was the intestine forced through the mesentery during the writhing and agony consequent upon the passage of a biliary calculus? No gall-stone was found, and therefore the question remains open. It is true that there are many cases of external hernia where the stricture was very tight, and where agonizing pain was quickly developed; it is true that in some of the cases on record of internal strangulation, violent suffering has occurred suddenly, and therefore the urgency of the first symptoms do not constitute a sufficient reason for believing that, strange though it be, the intestine may not have been protruded through the opening at the moment the pain came on, and the patient at rest; but the opening was so small that it seems scarcely possible to have happened in this case. In La Fayes' case there was no sensible inconvenience until the excessive pain occurred, and yet the patient was dead within thirty-six hours. The case in many respects resembles our own, and there are on record others not unlike it.

Whatever explanation may be adopted, I apprehend the question of gastrotomy could hardly have been entertained in that case.

The impression which must be produced by reading the preceding cases is this, that, no matter what may be the cause of the obstruction, no certain remarkable difference is observed in the more prominent symptoms by which it is accompanied. There are in all abdominal pain, abdominal tension, obstinate constipation, and sickness; but in the mode of their occurrence it would be difficult to point out any distinct difference. Thus constipation, abdominal pain or uneasiness, with tension, and sickness of the stomach, are present, in greater or less intensity, in most cases, but there

is no certain and definite line to be drawn, either as to the time at which they occur, or the severity with which they are ushered in, whether the obstacle be a biliary calculus or a band of false membrane.

The constipation may have the same general characters, whether the obstruction be caused by hardened fæces, by a contraction depending upon ulceration or other disease, by bands or by tumours: this is certain. It is true that some cases of invagination are accompanied by diarrhœa or by dysentery, but in the great majority of cases the constipation is complete.

The same may be said of sickness; it is usually a very distressing symptom, and ends in fæcal vomiting: but it may be as obstinate in a case of invagination, as in a case of tight strangulation of the ilium by bands. It may be as urgent, and the vomited matter may as soon assume a fæcal character, in a case of invagination, as in a case of the passage of the intestine through an abnormal opening. The abdominal tension is often excessive, but there are on record many fatal cases, where it was not so great as to occasion the patient much distress; and in some instances the abdomen has been quite flat, and, no matter what the obstructing cause may be, the gaseous distention of the intestine may equally take place, and with equal intensity.

Taking the symptoms altogether, it is true that when the obstruction is complete and suddenly developed, they are usually more urgent than when it is slowly produced; but there are cases in which the obstruction has terminated life, within forty-eight hours, without much sickness or severe pain. In cases of invagination, or where a tumour gradually encroaches upon the calibre of the tube, where the canal becomes contracted by change of structure, the pain does not commonly, even up to a late period, exhibit so much intensity as in the former case. But I say again, that we cannot with confidence rely upon these distinctions, the exceptions are so many.

For some time I had hoped that by arranging the cases in

small groups the symptoms might be made to assume a more characteristic form; but I found that distressing sickness, severe pain and abdominal tension might be present or absent in any case, no matter what may have been the cause of obstruction: that life might be extended as long in a case where the intestine passed through an unnatural opening, as in a case of gradual malignant contraction.

It is of course desirable to know the *seat* of the obstruction; but we shall be unable to obtain that knowledge in many cases. There are, however, certain means which we must not lose sight of, which will materially assist us in coming to a conclusion: there are others, upon which some persons rely, which will prove only broken reeds. Thus it is said that the vomiting and pains are more severe when the obstruction occurs in the small than in the large intestines, and I think there is some truth in the remark; but, after an anxious consideration of the cases before me, I find the exceptions to the rule so many, that I do not think we can safely rely on it. It has also been said that much assistance may be derived from observing the condition of the urinary secretion; that if it be copious, the obstacle must be far removed from the stomach, and *vice versâ*; but the exceptions to this rule are also many.

Laugier thought that by a careful examination of the distended convolutions of intestine, much assistance might be derived in determining the seat of the obstruction; and to a certain extent he is right: but in some cases the distention is trifling, and in all cases the examination must be made before the general abdominal tension is considerable, or it may be difficult to profit by it. There are many cases in which a careful examination of the distended intestines will afford most important assistance, in determining the seat of the obstruction. It is true that in a case where the ilium is obstructed near its termination, the jejunum and the ilium may be so much distended, that it may seem difficult to determine whether the distention affects them or the descending colon; but the absence of distention of the ascend-

ing and transverse colon will go far to remove the obscurity, especially when assisted by an exploration, by means of a long tube, per rectum. There are, certainly, cases in which we may satisfactorily follow a distended intestine up to the point of obstruction, but there are many more in which this sign will fail us. However, it has been found useful in diagnosis, and we must take it for what it is worth. In Mr. Luke's case, described hereafter, he found the colon distended down to the sigmoid flexure, and that fact, added to the impossibility of passing a tube far up the rectum, or throwing up much fluid, left little doubt on his mind that the lower part of the colon was the seat of the obstruction; and he was right.

It must, however, be borne in mind, with reference to the tube, that it may produce an error in diagnosis: it may reach the obstruction and then be bent back upon itself; this has happened in my own experience and also in that of Mr. Luke.

Still the history of the case, the particular seat of pain, the occasional existence of a tumour, which is now and then detected in cases of invagination, and indeed in some other cases, before there is much abdominal tension, the distended convolutions, the long tube and the injection, will usually afford us most important assistance in coming to a conclusion, as to the seat of the obstruction. At the same time, it is certain that in the experience of the ablest men they have failed.

The diagnosis being at best but uncertain,—though it may be sufficiently conclusive to justify us in acting upon it,—it is proper to inquire into the results of the treatment usually employed, because, if those results be not very unfavourable, the doubtful diagnosis, and the gravity of operations performed upon the abdominal cavity, might stand in the way of our having recourse to them.

Certainly in a large number of these cases the symptoms are aggravated by the drastic treatment employed for the purpose of overcoming the obstruction; and although I admit that Croton oil and such irritants have occasionally succeeded

in relieving the obstruction, in most cases I am confident they have left matters worse than they found them. Opium and blood-letting have in many cases allayed irritation and spasm, and Calomel given, at the same time, in large doses, has sometimes seemed to exercise a happy influence over the obstruction, and not least in those cases where its appropriate action has been excited in the system. Associated with such means, enemata, of various kinds and quantities, frequently repeated, are most valuable.

Of the cases to which I have referred, 169 in number, and subjected to various modes of treatment, certainly 133 terminated fatally. If they constitute a fair average of the results of such cases, I apprehend there can be no doubt that where a disease terminates fatally under ordinary treatment, in seven cases out of nine, it will be granted that it is proper to entertain the question, whether a better chance of life be afforded by surgical operation. It must be understood, however, that I do not insist upon that average of results as being absolutely correct; but it was the only means I possessed for obtaining data on a large scale in severe cases, and it is at all events an approximation to the truth, for I apprehend that most of the severe cases which have been successfully treated have found a record. There is no doubt that a large number of cases of obstinate constipation do yield to ordinary treatment, but it is probable that in many of those cases the obstruction did not depend on mechanical causes at all.

Before I express my own opinion, or the data on which it is formed, as to the expediency of having recourse to surgical operations for the relief of intestinal obstructions, I will shortly refer to those of several men who have carefully considered the subject.

Hevin concludes his Memoir* by saying—" How are we to remedy those cases in which the symptoms may be so similar, the causes so different, and which, though so formidable,

* Mem. de l'Academie de Chirurg., tome iv. p. 201.

present no positive sign to mark the nature of the cause, or the situation which it occupies? It is clearly out of the domain of operative surgery." At a later period, he says that if a band could be detected it would clearly prescribe gastrotomy, because the section of the band may save life: but, he adds, unfortunately we cannot distinguish it by any certain sign.

Mensching said, "that in the uncertainty of our diagnosis, few men could be found so little jealous of their reputation, and having so little scruples of conscience, as to dare to perform an operation which must expose the patient to so much danger."

Manoury, who applied himself with much success to this question, says,*—"The operation of gastrotomy is sometimes indicated; it should be performed before the inflammation is considerable: the incision ought to be made as near as possible to the point where we suspect the strangulation to exist." "If the operator does not find the seat of strangulation, or if this strangulation be of a nature which cannot be removed by operation, it may be convenient to establish an artificial anus, by opening the intestine, between the stomach and the point of strangulation."

Bonnet says,†—"After having witnessed the miserable end of persons who were the subjects of those obstructions, the autopsies have convinced me that an operation might have saved life. I have sought and found cases favourable to my opinion, many which are in opposition to it, still more which were not worthy of confidence. I have seen cases in which an operation ought to have succeeded. I do not dissimulate the gravity of the question that I have raised, and which should only be resolved by experienced surgeons. And if in the eighty years that have passed since Hevin wrote his Memoir, surgery, anatomy and pathology had remained stationary, I should have abstained from agitating the question; but it is not by eluding a difficulty that we surmount it."

Otto says,‡—"At the commencement of the disease,

* Thèse de Paris, 1819. † Thèse de Paris, 1830.

‡ Prax. Med., Part 2, p. 13.

when the powers of life are in all their integrity, there is no reasonable surgeon who would decide upon such an operation, so many means ought to be employed before recurring to such an extreme measure. But in the event of all remedies being fruitless, the operation must have a very doubtful value, for of two things, one will happen,—either the powers of life will be so exhausted, that the patient will be unable to bear up against the consequences of the operation; or, the intestines may have become almost gangrenous: so that, in one or the other supposition, the patient's life will be lost."

Boyer says, in reference to this operation,*—"If we consider, 1st, that ileus may be the effect of a great number of causes; 2nd, that the symptoms being nearly always the same, whatever may be the cause of the constipation, it is impossible to determine, in each particular case, the cause of the disease; 3rd, that supposing even we could determine the cause, there is no index to mark the precise seat of the disease, and that, to discover it, a search is necessary, which is pregnant with great danger; 4th, that in invagination, the inflammation which is commonly set up determines adhesions, which render the disengagement difficult, if not impossible;—if we consider all the circumstances, we shall be convinced that there must be temerity in resorting to gastrotomy; and what I said of volvulus applies, without any restriction, to another species of intestinal strangulation which has been many times observed, and which is formed sometimes by bridles acting like ligatures, sometimes by an abnormal opening in the mesentery in which a portion of intestine is implicated."

Dupuytren says,†—"Internal strangulations have no fixed seat; their formation is independent of any constant organic disposition. The circumstances of their development are accidental and very variable; nothing sufficiently marks the interception by an obstacle capable of being removed, from that which is irremediable by operation. Their symp-

* Traité des Maladies Chir., t. vii. p. 491.

† Sabatier, Med. Operatoire, par Begin et Sanson, t. iii. p. 503.

toms are not defined, and are therefore doubtful, and the means to be used by the surgeon for their relief are inefficacious or dangerous."

Our experience of operations upon the abdominal cavity for the relief of obstructions is now, I think, sufficiently large to justify us, from the results, in adopting some rule of conduct; and the fact of the great probability of loss of life under ordinary treatment, the comparatively successful results of operations upon the abdominal cavity in modern surgery, and our experience of surgical interference in cases of obstruction, may, though in opposition to some of the foregoing opinions, seem to warrant a recourse to gastrotomy, when the diagnosis is sufficiently clear.

Let us now see what that experience is. It extends to fifty-three cases. In twenty-six instances gastrotomy was performed on infants, for the purpose of establishing an artificial anus, the natural passage being imperforate. In twenty-seven instances the operation was performed upon adults, for various kinds of obstructions. I will describe in detail those cases which are either little known or unpublished, and will merely refer by name to those which are better known.

It is stated by some persons, but without any clear proof of the occurrence, that Praxagoras performed, or at least recommended, the operation of gastrotomy in a case of obstruction. That he did not perform it, is pretty clear. Whether or not he proposed it, depends upon the sense in which we accept the following expression, in Cœlius Aurelianus :*—"Vomitu utitur donec stercora faciat evomi. Aliquos etiam post vomitum phlebotomat, et vento per podicem replet." "Item confectis quibusdam supradictis adjutoriis, *dividendum ventrem* probat pubetenus." Le Clerc and Clifton believed that gastrotomy is here clearly indicated. Hevin and Haller concluded that the passage refers to the common operation for hernia.

Whatever may be thought of the passages from Cœlius

* Acutor Morbex, lib. iii. cap. 17, p. 244.

Aurelianus, one from Barbette* presents no such ambiguity:—"An non etiam præstaret, facta dissectione musculorum et peritonæi, digitis susceptum intestinum extrahere, quam certæ morti ægrotantem committere."

Bonetus,† in referring to Barbette, appends the following note, to prove that Barbette's recommendation had been carried into effect:—"Illustr. Baronissa a Lanti prope Castilionem ad Sequanam in Burgundiæ ducatu iliaco affectu laborans, pro deplorata habebatur. Offert se juvenis chirurgus diu castra secutus qui salutem certam pollicetur, modo nobilis ægra sectioni in abdomine faciendæ se submittat, concessam aggreditur chirurgus, multisque adductis et evolutis intestinis antequam convolutio et contortuplicatio appareret eam nactas explicat, et nodos dissolvit, post modum sedi restituit; hinc gastroraphia facta, vulnus felicissimo successu consolidavit, integræque valetudini nobilem restituit; quæ sospitali suo stipendium annuum constituit, cujus usura per triennium tantum frui licuit supervixit enim matrona."

Doubts have been thrown on the nature of the operation performed in that case. It was not seen by Bonetus, but it was communicated to him by the Rev. Mr. Pinault, a minister of the Genevese Church, who lived on terms of intimacy with the lady; and it is made matter of question whether the operation was not an ordinary one for strangulated hernia; but I think those who doubt are here rather sceptical.

The case detailed by Velse, and authenticated by Oosterdykius Schacht, is too clear to admit of any doubt:—"A woman, aged 50, exhausted by the suffering from ileus, deriving no relief from the various remedies employed, Nuck, who was consulted, pronounced the case to be one of intussusception, and requested an able surgeon to make an opening on the left side of the abdomen, at four fingers' breadth from the umbilicus, and in a direction obliquely

* Oper. Chirurgico Anat., 1672, de Abdom. partib. inter., pars iii. lib. iv. p. 144.

† Sepulchretum Anatomicum, lib. iii. sect. 14, p. 228, de dolore iliaco.

downwards and outwards. The intestines were drawn out and fomented with warm milk, while search was made for the invagination. It was found, and gently withdrawn. The intestines were then returned, the opening was closed by sutures, and the lady survived the operation twenty years."

Manoury* mentions the case of a man, aged 57, who, after eating three pounds of cherries, stones and all, experienced, during the night, severe pain in the right iliac fossa, with incessant vomiting. There was obstinate constipation; the belly was tumid; the vomiting became fæcal. Operation was determined on. An incision was made in the linea alba. Great adhesions were found, and, from the right iliac fossa, purulent matter escaped. The obstruction was not discovered, and the patient died. Upon examination after death, it was found that the obstruction was caused by a band stretching from the mesentery to the cæcum, under which a portion of ilium passed, and became strangulated.

Fuschius† describes the following case:—The patient, a man of 28, experienced sudden violent pain on the right side, a little below the umbilicus. Vomiting came on; there was obstinate constipation. The belly was not tumid, but a tumour could be felt where the pain was most severe. An operation was proposed and performed. Invagination was quickly discovered, the intestine was disengaged, and the patient recovered.

Recamier's case presented all the usual signs of obstruction; the greatest amount of pain was in the right iliac fossa. An operation was determined on, and Dupuytren was requested to perform it. He thought the incision through the abdominal walls should be made on the right side. Recamier insisted that it should be made on the left. The operation was performed accordingly. Search was made for the obstruction; the adhesions were extensive, and, when the hand was passed towards the right iliac fossa, pus gushed

* Thèse de Paris, 1819.

† Journal der Pratischen Heilkunde, 1825.

out. The operation was not proceeded with; the obstruction was not found; the wound was closed; and the patient died. Upon examination after death, a portion of small intestine was found twisted around a band extending from the mesentery to the cæcum.*

In 1833, Reybard was requested to see a man, aged 28, who had had a suffering life for many years. During the previous six months his sufferings had increased. He had severe lancinating pain, extending into the left hypogastric region. The abdomen was enormously distended. By a careful examination he discovered a hard and apparently moveable tumour, as large as an apple, in the left iliac fossa. The distended colon could be distinctly followed. There were constant eructations, and the evacuations were very small and unfrequent, of a puro-sanguinolent character, and accompanied by tenesmus. Enemas could not be retained. An exploration was made by the rectum, by means of the finger, but no tumour was detected. Reybard satisfied himself that the tumour, which could be felt, was probably carcinomatous, and that it occupied the sigmoid flexure of the colon. He advised an operation, and the patient submitted to it. An incision, six inches long, was made, parallel to, and an inch and a half above the crest of the ilium. The peritoneum was opened to the extent of three inches. The tumour was found to implicate the intestine. It was removed with three inches of intestine; and the ends were carefully brought together by sutures. Everything went on well until the fifth day, when the abdomen became tympanitic; the lips of the wound were dragged apart by the tension. Under leeches and poultices the suffering abated. On the seventh day he was much better, but there had been no stool. On the tenth day, after an enema, the patient had a stool. Thirty-eight days after the operation he took solid food, had natural stools, and the cicatrization of the wound was complete. In six months, there was a return of lancinating pain, there was

* It is doubtful whether this description and that of Manoury do not apply to the same case.

a reproduction of the tumour, and he died about twelve months after the operation. The body was not examined after death.

In the "American Journal of the Medical Sciences"* are the following cases—one by Mr. Manlove, the other by Dr. Wilson:—

Mr. Manlove's patient was a boy aged seventeen, who had suffered from obstinate constipation for twelve or fifteen days. There was vomiting; the abdomen was enormously distended; the extremities were cold, and the pulse was feeble. An incision was made on the median line; it extended nearly five inches. Extensive adhesions were immediately perceived. The intestine was punctured, apparently unwittingly. No further search was made for the obstruction, and an artificial anus was established. Fæcal matter passed freely from the wound until the seventeenth day, when it took its natural course, and the patient recovered.

Dr. Wilson's case was a negro man. He had obstinate constipation and vomiting, with the usual signs of obstruction. Dr. Wilson concluded that there was invagination. An incision was made, and the intestines were pulled out until the obstruction was discovered. At a point in the ilium an invagination, to the extent of an inch, was found; it was disengaged with some difficulty, and the patient recovered.

Monod's case† was a woman, aged 25. Some time before she came under treatment she had received a blow upon the abdomen in the ilio-cæcal region. There were constipation and pain in the neighbourhood of the right iliac fossa, and a large hard tumour was discovered there; and after some time vomiting came on. The vomited matter soon acquired a fæcal character, and the other symptoms became very urgent. Gastrotomy was determined on. An incision was made at the point where the tumour was found. A dis-

* Vol. x. p. 235.

† Archives Gen. de Med., 2nd Serie. tome ii. p. 455.

tended intestine was immediately apparent; it was punctured, and an artificial anus was established, but no further search was made for the obstruction. The patient died. Upon examination after death, the cæcum was found so contracted that it would scarcely admit a female catheter. The intestine which was punctured was the ilium.

In Mr. Luke's case the patient was aged 41. He had not been a sufferer from constipation until nine days before his admission into the London Hospital. The constipation had been complete for eight days, and there were flying pains extending from the left iliac region over the abdomen, accompanied by tension. There was constant vomiting. Purgatives were administered by the mouth and the rectum, and calomel and opium were given every four hours; within forty-eight hours there was incipient ptyalism. The constipation persisting, a tube was passed per rectum, apparently to the extent of twenty inches. At a later period it was introduced by Mr. Luke, who ascertained that it did not penetrate beyond the rectum, but became folded upon itself. Mr. Luke being satisfied, from the exploration with the tube and the other signs, that the obstruction existed at the termination of the colon, it was determined, on the sixth day after admission, to make an exploratory puncture in the left iliac fossa. The incision was four inches in length. Upon opening the peritoneum the intestinal tension was found to be so great as to make it necessary that the external opening should be lengthened. Even then, difficulty was experienced in getting at the obstruction, and it was not accomplished until the gaseous distention of the intestines was relieved by the introduction of a small trocar. The intestine was then slit up to the extent of an inch and a half. The finger, passed through the opening in the gut, detected the stricture, which felt like a circular induration. The patient slept during the night; next morning the sickness was unabated; the tension was still considerable. He died within twenty-four hours.

*Post-mortem.*—The small intestines were found much in-

flated. The colon had twice its usual diameter. The peritoneum enveloping the transverse colon was ruptured to the extent of about six inches. The stricture was situated about eight inches from the anus, in the sigmoid flexure of the colon, and occupied about five inches of the gut. It was completely impervious, and was the result of chronic thickening.

In the case treated by Dr. Bird and Mr. Hilton, and published in the last volume of the Society's Transactions, the patient was 20. The constipation was almost complete for many days. The diagnosis formed was, that there was strangulation of the small intestine by bands, and, ordinary means having failed, gastrotomy was performed. The obstruction was discovered, the intestine was liberated, and the patient survived the operation nine hours.

Dr. Todd's case was a man of 26, subject, from his boyhood, to attacks of pain in the abdomen, accompanied with constipation. The present attack commenced April 25. The pain was at first severe, with sickness, pulse 85. Opium and fomentations were ordered, and produced relief. The pain and sickness returned. Aperients were introduced by the stomach and rectum, but the symptoms became more urgent. Pulse 140. A warm-bath, with warm-water injections, and leeches to the abdomen, were now ordered, but without much relief. The most severe pain was around the umbilicus. The abdomen was much swollen and tympanitic, especially around the umbilicus. Mercurials, with opium, by the stomach, and mercurial inunctions, were now tried. On the 29th the vomited matter was brownish and pultaceous, the pain about the umbilicus was increased on pressure. The abdomen was more generally tender; there was dulness on percussion in the right iliac fossa, over the cæcum. Ordered that the bowels be inflated with air. This was done, but it caused a great feeling of distention; however, the patient thought he afterwards experienced relief from it.

30th.—To have hyd. chlor. gr. x. opii gr. j. statim, and to be repeated at night.

May 1.—The dulness was still marked over the cæcum and

around the umbilicus. A larger quantity of air was injected again, and the tube was passed up the rectum to the extent of fourteen or fifteen inches. It was bent when it was withdrawn.

May 2.—He complained of more pain, the abdomen was more tender, the matter vomited was more suspicious, though not distinctly stercoraceous. To take Ex. coloc. comp. gr. x. Ol. croton ♏ij. 2$^{dis}$ horis. Ol. ricini, Sp. tereb. aa. ℥j. Ol. croton ♏v. fiat enema, statim utend.

This evening a consultation was held, and Mr. Simon performed an operation for the formation of an artificial anus in the right iliac region. The intestine was exposed, secured and punctured, and about forty-eight ounces of a light-coloured fæculent fluid escaped. The obstruction was found not to exist in the ascending colon as was imagined, but probably in the small intestine. It was necessary to support the patient by stimulants during the operation.

May 3, 4 A.M.—He has been very restless since the operation was performed, and he has vomited continually. He died at 8 o'clock. At the post-mortem inspection a band was observed extending from the mesentery across to the mesocolon; and a portion of ilium was found implicated and strangulated by it.

In Pillore's case of obstructed rectum the patient died on the twenty-eighth day after operation.

In Fine's case the operation was performed for scirrhus of the rectum: the patient survived three months and a half.

In Freer's case, for stricture of the rectum, the patient died on the eighth day after operation.

In Pring's case, also for stricture, the patient recovered.

In Markland's case of stricture the result of the operation was also favourable.

Of Amussat's four cases of obstructed rectum, three patients recovered from the operation.

In Velpeau's case the operation failed.

In the two cases described by Dufresse-Chassaigne the operation was successful.

In Evans's case of contracted colon the patient survived the operation several months.

In Maisonneuve's case of stricture the patient did not survive the operation many hours.

Of the twenty-six cases in which the operations of Littre, Callisen and Amussat have been performed, in infants, for imperforate anus, in each instance the incision was made in the left iliac fossa, or in the left lumbar region, and an artificial anus was established. Of these, eight were successful, the patients survived at least a year; twelve died within a month; and six were doubtful; at least the history is defective.

I have found nineteen cases in which artificial anus was formed, in adult life, for obstruction in or near the rectum. In seventeen cases an incision was made either in the left iliac fossa, or the left lumbar region; and in two instances an opening was made in the right iliac fossa. Of these operations nine were successful.

In eight instances the operation was performed at other points of the abdomen, and without the establishment of artificial anus; and of those, four appear to have been successful.

These operations, formidable as they no doubt are, are at last only modifications of operations which we undertake every day; namely, those performed for the relief of strangulated hernia. The advantages in favour of the latter are the following: there is more probability that our diagnosis as to the nature and the seat of the strangulation will be correct, and the abdominal cavity is exposed to a smaller extent. And, even with those advantages, more than one case in three terminate fatally. In the present operation, apparently fourteen out of twenty-seven have failed. But, even in ordinary cases of strangulated hernia, we may be deceived as to the seat and the nature of the strangulation. We may have an external hernia; we may operate; but the patient dies; and an internal strangulation is discovered at a distance. In

Velpeau,* such cases are referred to. Mr. Hewett kindly communicated to me two cases in which there was external hernia; but after death it was found that the symptoms of strangulation were caused, in one case, by a small obturator hernia; in another, by a very small femoral tumour. In my own experience, at the same time that there was a femoral hernia in a state of strangulation, the commencement of the rectum was blocked up by a fibrous mass. Still these cases are not of ordinary occurrence, and it must be admitted that the diagnosis in external hernia is much more satisfactory than in those cases where the obstruction is situated internally. I am, however, of opinion that, when those internal obstructions have been more carefully studied, we may be able to determine, in some cases the nature, and, in others, at the least the seat, of the obstruction, with more accuracy than has been hitherto usually done.

With the exception of cases requiring the Cæsarian operation, the ancients do not seem to have entertained the idea that gastrotomy was a justifiable operation. I know it was the opinion of Le Clerc, that Praxagoras recommended a recourse to it, in cases of obstruction, when other means failed; but I am not satisfied that his advice was acted upon: and, indeed, I am in doubt whether, in later times, the case of the Baroness Lanti, mentioned by Bonetus, was not something more like our ordinary operations for hernia than what we regard as gastrotomy in the present day.

Whatever dread deterred men from making incisions into the abdomen formerly, little of it now remains among ourselves. The impunity with which extensive wounds have been made in the abdominal cavity, for the purpose of extracting ovarian tumours, or cysts, has left a very general impression that such wounds are much less dangerous than was formerly believed. That this impression may cause a somewhat reckless disposition to resort to operations upon this cavity is, I fear, to be apprehended. I am by no means certain, how-

* Med. Op., Art. Hernie.

ever, that the results obtained from operations performed for the extraction of a fœtus, or the removal of an ovarian cyst, can be properly applied to the question, where the case is one of obstruction. In the former cases there is probably no inflammatory action existing. In the case of an ovarian tumour, I think the peritoneal surface is considerably modified, less disposed to inflammatory action than in health; whilst, in cases of obstruction, we shall not be justified in proceeding to operation at an early period, as we might do in a case of external hernia where the diagnosis is simple; but we shall probably wait until a state of things is developed in the part which must be very unfavourable to the success of such an operation. Still I say, that in many cases it is our only resource, and that it is not without promise of success; and I conceive that when it appears that, under ordinary treatment, so large a proportion as seven out of nine of these cases of obstruction from mechanical causes terminate fatally, and that, of the cases submitted to operation, thirteen out of twenty-seven have terminated favourably, we are justified, even in the present imperfect state of our diagnosis, in having recourse to an operation which affords such increased chances for the preservation of life, provided we can satisfy ourselves as to the nature of the obstruction.

The ground having been so far cleared, we come to the question, when is it proper to proceed to operation? and probably of all points connected with the subject this is the most difficult of solution. If we could say that the obstruction was complete and not removable, we could not proceed to operate too early; but this we cannot do: the obstruction may give way after many days, when even fæcal vomiting has supervened: and when it is borne in mind that probably a third of the cases of obstructed bowels are caused by invagination, and that of such cases nearly a fourth recover under ordinary treatment, our difficulties are not lessened.

Still we have ultimately to decide whether ordinary means should be further persevered in, whether the patient is to be

abandoned to his fate, or whether recourse should be had to operation. In reference to this question Dr. Watson says, "Common sense and common humanity answer, you must abandon ordinary means the instant you are convinced that there is a mechanical obstacle which cannot be overcome." But he says again, and truly enough, "But how are you to know this?" Here his suggestions are, as usual, judicious:— "We fear the existence of some hopelessly impassible mechanical impediments when, the constipation being obstinate, we discover a tumour or hardness in some part of the belly; or when we receive a history of some former inflammatory attack, since which the bowels have been habitually difficult to regulate. Our fears are strengthened when the patient feels that the injections reach a certain spot, and there always stop, and that the intestines rumble and roll and propel their contents downwards to the same spot, and no further. And this is the distinctive symptom on which I wish to fix your attention. The abdomen gradually enlarges, especially if the patient is able to retain food; the intestines fill up above the obstacle; and the throes of pain occur, attended with sickness; and during these pangs you may feel immense coils of intestine, as big perhaps as one's arm, rise and roll over with loud roarings and flatulence. When this takes place, the time for giving purgatives is certainly over."

But it has been said, supposing the operation to be undertaken, is it certain that the obstruction can be removed? I apprehend not. It is true that in a case of invagination we may be unable to withdraw the invaginated portion, and that in a case of contraction from diseased parietes we may be unable to dilate it; that in a case of intra or extra intestinal tumour we might be unable to remove it; but whatever the nature of the obstruction, supposing it not to be susceptible of relief by operation, it is in our power to make an artificial anus, as near as we can get to the seat of the obstruction; and the existence of such an infirmity, even when incurable, is consistent with a considerable extension of life, unless the opening be nearer the stomach than it need be in ordinary

cases of obstruction, which are usually found not higher than the inferior portion of the ilium.

Believing that many practitioners will be able to make up their minds that the time is come for something more decided than croton oil, or calomel, or quicksilver, and that operation is justifiable, the question remains, where is the incision to be made? There are some cases where the seat of obstruction is so clearly indicated that no doubt remains. In such cases I apprehend the rule is evident; the incision should be made as near as is prudent to that point. But supposing the point of obstruction to be only obscurely marked, or, indeed, not discoverable at all, then I conceive the incision should be made on the median line, because an opening in that situation may be found most convenient for liberation, if that be practicable, or for the establishment of an artificial anus, supposing liberation of the intestine be not accomplished.

The experience we possess shows that, whatever may be our notions or plans of relief, there are not more than two well-authenticated cases in which constricting bands have been severed; and with the exception of cases of invagination, not more than two cases in which the integrity of the intestine has been respected, and the obstacle successfully removed; but there are many in which life has been saved by the establishment of an artificial anus; and I apprehend it is to that point our attention must be most earnestly directed.

The conclusions to which I come, after a careful review of all the circumstances to which reference has been made, are as follows:—

1st. That intestinal obstructions, dependent upon causes acting within the abdominal cavity, are by no means of rare occurrence.

2nd. That they may occur at any period of life; and that although a particular variety of obstruction may be more frequently seen than another, at a particular period of life, there are still so many exceptions to the rule that we cannot rely much upon the probability that a particular obstruction is present at a given period of life.

3rd. That the diagnosis of the existence of an obstruction is usually not difficult.

4th. That the diagnosis of the nature and the seat of the obstruction is, in most cases, most uncertain and unsatisfactory.

5th. That beyond the general history of the case, the most probable means of ascertaining the seat of the obstacle is, to follow carefully the distended intestine up to the point of obstruction.

6th. That under ordinary treatment these cases are fatal in the proportion of, probably, seven out of nine.

7th. That although no reliance can be placed on purgatives, on mercury, on opium, or any variety of injection, and that although in many cases they seem to aggravate the suffering, yet as it is unquestionable that in some cases they have been administered with relief, we cannot advise that they should be discarded, but we doubt the prudence of continuing to use them beyond two or three days.

8th. That the interference by surgical operation is justifiable when three or four days have passed without any relief from ordinary means (provided the constipation be complete and vomiting of fæcal matter continue), because it affords a greater chance for the preservation of life than ordinary means.

9th. That if the indications as to the seat of the obstruction be sufficient to satisfy the surgeon, it is at or near that point that the incision should be made; but if there be much doubt, it is most prudent to make the incision on the median line.

10th. That if it be found impracticable to remove the cause of the obstruction, or imprudent to make any extended search for it, relief may be obtained by forming an artificial anus as near as may be prudent to the seat of the obstruction; and that if it be, as it frequently is, near the termination of the ilium, an incision on the median line admits of its accomplishment as near as may be to the termination of that intestine.

CASE

OF

# MALIGNANT TUMOUR OF THE OS UTERI,

## EXCISED DURING LABOUR.

By JAMES MONCRIEFF ARNOTT, Pres.,

SURGEON TO THE MIDDLESEX HOSPITAL.

Received Nov. 15th—Read Nov. 23rd, 1847.

The practitioner in midwifery is aware that the presence of malignant disease in the uterus is not an absolute bar to pregnancy, but he is also instructed that, seated in the os and cervix uteri, it may form a serious and even fatal obstacle to delivery.

Instances of this combination are happily not of frequent occurrence, yet Puchelt, in his work entitled "Commentatio de Tumoribus in Pelvi Partum impedientibus," published at Heidelberg in 1840, has collected thirty cases of scirrhus and cancer with pregnancy, and to these we may add seven others classed under the head of cauliflower excrescence, with pregnancy. Labour under these circumstances, always attended with difficulty and delay, presents very unfavourable results: of thirty-seven women, five died undelivered, four of them with ruptured uterus: of thirty-two in whom delivery was effected by the efforts of nature alone or aided by art, sixteen were lost during labour; thirteen lived over their confinement, and of three the fate is not noted. Of the children, seventeen were born dead, in addition to the five undelivered, and of five no account is given.

The assistance rendered by art was in some of these cases by operations purely obstetrical, as turning, and the applica-

tion of the forceps; but in two instances, incisions of the diseased parts were made, and in one they were excised.

It is with reference to the last-mentioned mode of relief that I am induced to bring the present case under the notice of the Society, partly on account of its rarity, partly because excision may have been overlooked as inapplicable, or has been too absolutely condemned.

In the authorised published abstract of the proceedings of the Obstetric Society of Edinburgh for the present year, it appears that at the meeting on the 10th of February last, Dr. Simpson stated that he had met with two cases of carcinoma uteri with pregnancy, in which the women had gone to the full time. In one the neck of the uterus was affected; it burst during the progress of labour, the child was still-born, and the woman died immediately. In the other the woman had been ill for three days; she was very much exhausted, and her pulse very rapid. The cervix was indurated at one side, and did not seem at all inclined to yield. Two or three small incisions were made through the indurated portion. This allowed the head to pass, and the delivery was completed after five pains. It was too late, however; the patient's pulse never rose, and she sank in two or three days afterwards.

Having alluded to a case of the same nature, which had occurred at some distance from Edinburgh, and in which delivery was effected by craniotomy, Dr. Simpson expressed his doubts as to the propriety of the operation, and argued that if in any instance we are justified in trying to save the child, at the expense of some additional immediate risk to the mother, it is in the case in question, where the mother's life is, from existing disease, not worth more than a few weeks' or, at most, a few months' purchase. He would recommend that the diseased and obstructing part be freely incised before the patient's strength is exhausted, for Nature generally at last effected this very operation by her own efforts; that is, the parts at last became torn and lacerated, but often when it was too late.

In a recent and esteemed English work on the diseases of the uterus, after incisions have been advised, it is stated that the practice of *excision* is one not adopted in this country, and one which, in the author's opinion, is not at all practicable, much less advisable.

It will, I think, be felt, after the perusal of the following account, that there may be cases in which it is both advisable and safe.

On the 4th November 1844, a lady applied to me, at my house, to have an excrescence, as she termed it, removed from her womb. On examination, I found the anterior lip of the os uteri enlarged and indurated, its surface smooth generally, but rugged and granular round the os itself, which was represented by a mere chink, and was with difficulty made out. The cervix above the enlargement seemed to be in a natural state. Examination gave no pain, but under it the parts bled.

The patient, a fine healthy-looking woman, 38 years of age, married, and the mother of several children, had not menstruated regularly for five months; but during that period she had had several momentary gushes, which stopped as suddenly. She was larger than natural, and had been sick.

I explained to her, that what she had, was not a mere wart or excrescence to be snipt off before she left my room, as she had expected; still that it might be removed; but before doing this, as there was a suspicion of pregnancy, and for other reasons, I desired a consultation. Accordingly Dr. Ferguson and I met, and then associated Dr. Locock with us.

In consultation, it was agreed that the disease was one not to be remedied but by its removal. It was also agreed that the state of the cervix uteri above, authorised this being done. But it was decided that the patient was at the fifth month of pregnancy; and it was determined that nothing in the way of operation should be attempted until after the patient's confinement, when excision of the cervix uteri

should be performed, as soon afterwards as it could with propriety.

Four months after our consultation, on the morning of 2nd of March 1845, I received a note from Dr. Locock informing me that our patient was in labour—that it would be necessary to remove the morbid growth at once, and requesting me to come provided with the requisite instruments for that purpose.

I learnt from Dr. Locock, on my arrival, that labour had commenced two days previously, when the liquor amnii had escaped—that he had been with the patient during the preceding night—that the head did not and could not advance owing to the contracted state of the os uteri and resistance offered by the tumour—that sufficient time had been allowed for the parts to yield—that the patient's safety would not admit of delay, and that the tumour must be removed to allow of delivery taking place.

On examination I found the anterior lip and right side of the os uteri occupied by a hard rugged tumour of oval form, and of the size of a large green walnut. Its limits were clearly defined, and the tissue beyond, and as far as could be ascertained around, seemed to be in a natural state. The posterior lip of the uterus was soft and thin, and the os admitted two fingers, but beyond this it had not yielded for many hours.

During a pain the tumour and contracted os uteri were forced down by the child's head, nearly but not quite within sight.

Assenting to the view of the case taken by Dr. Locock, I proceeded to fix the hooks of a pair of Lisfranc's forceps into the morbid growth, and upon this traction was made by Dr. Locock. I had proposed effecting excision by a curved hernia bistourie; but found I could not get the parts sufficiently low to allow of this being applied. I therefore resorted to the scissors curved on the blades, and guiding and guarding the points by the fingers of the left-hand, I succeeded (by a succession of strokes, and cutting freely beyond it) in removing the tumour.

I had had some fear of hæmorrhage, but not a table spoonful of blood was lost.

Immediately after the operation the os uteri expanded so uniformly that you could scarcely distinguish the wounded surface from the rest. In a quarter of an hour a living healthy child was born. The lady had a good recovery; and at the end of the month everything had a favourable appearance.

The tumour measured two inches and a half in length (in the direction of the circumference of the os uteri), one inch and a half from above downwards, one inch and a half in thickness. It had a knobbed character, and over one of the projections ulceration of the mucous membrane to the size of a shilling existed. The substance of the tumour, on a section being made, presented a yellow colour and fibrous appearance, not circumscribed by a defined margin, not nucleated, but gradually lost in the surrounding tissue.

In it, under the microscope, Mr. Tomes could not detect any appearances corresponding to those met with in scirrhus and cancer; but at one part of this fibrous mass near the ulcerated surface, and where it was of a greyish colour, and about apparently to undergo some change, Mr. Tomes discovered a few, a very few, cells of suspicious character.

The subject of the above case remained well for some months, when she was again subjected to attacks of hæmorrhage. On one of these occasions, eight months after her confinement, in the absence of her usual attendant, and when the quantity and effects of the hæmorrhage were somewhat alarming, I saw her, and found that, whilst the part from whence I had removed the tumour remained sound, the posterior lip of the os uteri was the seat of a similar disease, which extended upwards on the cervix beyond reach. The patient lived till June 1846, sixteen months after her confinement, when she died, having had, I understood, all the symptoms of malignant disease of the womb. An examination of the body was not allowed.

In this instance the lives of the mother and child, during labour, were saved by the extirpation of the diseased growth; but I do not pretend to say that the circumstances will often be so favourable for its successful performance as in this case; that is, being of limited extent, occupying but a portion, a half, of the os uteri, and not extending upwards so far as the reflected part of the vagina. The usual state of parts is no doubt very different, and they are represented in the following case, which has recently been under my care in the cancer ward of the Middlesex Hospital.

Elizabeth Simpson, 41 years of age, married, and the mother of nine children, sought admission into the hospital on the 5th of October last, on account of an ulcerated womb. Weaned her last child fifteen months ago, but had not menstruated since, excepting once profusely, in December. Discharge from the vagina began nine months ago. In May, it first became streaked with blood, offensive, and attended with pain in the back. In July she came into this hospital, and remained five weeks in the physicians' wards, where the nature of her complaint was recognised by Dr. West, on a vaginal examination. Has been out six weeks, and returns worse than she left.

On examination, the vaginal portion of the uterus was found to be enlarged, indurated, gristly. The anterior lip was of greatest size, but nearly the whole circumference had a rugged irregular character. The os was open; on the interior surface of both lips there was ulceration. The breach of surface on the posterior lip was excavated, as if by a knife. The diseased changes extended upwards, on the cervix, beyond the reach of the finger. The uterus was fixed in the pelvis.

About three weeks after she had been received into the hospital, this patient inquired *if it was possible* for a person in her condition to be pregnant—the reason of this inquiry being, something like fœtal movements which she had felt, accompanied with enlargement of the abdomen.

Dr. West being appealed to, decided that she was pregnant—about the fifth month.

Considering the difficulties and dangers which might attend her labour, and the probable necessity for incising the diseased parts, it was arranged that she should remain where she was, in the cancer-ward, Dr. West kindly undertaking to give his assistance when required.

Fortunately, as regarded the mother, about a fortnight afterwards premature labour supervened, the progress of which will be best narrated in Dr. West's own words.

"During the whole evening of the 11th of November, and day of the 12th, the patient had a good deal of uterine pain; at 7 P.M. on the 12th, it assumed the characters of labour-pain—at 8 P.M. discharge of the liquor amnii took place.

"During the night, the pains diminished in severity, so much as to allow the patient some rest, but came on again actively at 7 P.M. on the 13th.

"On vaginal examination, a loop of pulseless funis was felt through the os, which was now more open than twenty-four hours before; the posterior third being thin, soft, dilatable —the anterior two-thirds firm and unyielding.

"At 11 P.M. the right elbow was felt projecting, the uterus acting very energetically; difficulty was presented, not simply by the lips, but by the firm unyielding cervix uteri, into which some body seems to project from the anterior part or surface.

"At 1 A.M. the os was open to the size of a crown-piece, the body of the fœtus driven down into it, and the uterus forced down considerably with each pain, but the os is generally so rigid that the anterior segment of the uterus descends with the pains, whilst the os becomes directed so far backwards, that it is with some difficulty that it can be reached by the fingers of the left hand.

"Soon after 1 o'clock the pulse began to grow feeble, and from 108 rose to almost 120; the patient began to complain of great faintness, and to have frequent retching.

"A little brandy relieved these symptoms; the uterine action was almost unceasing, and extremely violent, but apparently with no effects on the os uteri. At a quarter to 2, I

left the room for about twenty minutes, and sent a note to Mr. Arnott, fearing there might be risk of the uterus giving way, unless the unyielding os could be incised.

"A few minutes after 2, I returned into the room, a most violent pain came on, a sound as of something giving way was heard, and a dead male child, at near the sixth month, was born double, the right arm and side of the chest being almost black from the squeezing they had undergone.

"Immediately above were felt the membranes of another fœtus, which gave way in less than five minutes, and a female fœtus was born footling. It made a few attempts to breathe.

"The placentæ were felt within the os, and slight traction by the cords removed them.

"The os uteri was now about three inches in diameter; no rent could be felt in it.

"On the evening of November 15th some uterine pain came on, and the pulse rose to above 120; it soon sunk, after a few leeches, to 106, where it had been before labour, and there has since been no grave symptom."

In cases similar to this, where the cervix is involved, when sufficient time has elapsed to enable us to ascertain what nature can accomplish, and that delivery can no longer be delayed with safety, incisions offer the first and best means of relief. When, however, the malignant growth occupies a portion only, the half, of the os uteri, then the possibility of excision should be kept in mind. That this may be done during labour, with safety, the case which I have related sufficiently proves.

## APPENDIX.

Elizabeth Simpson, the subject of the last-mentioned case, lived nearly six months after her labour. During this period she was confined to bed, and with other sufferings experienced severe and almost continued pain in the right iliac region, which was only mitigated by opium. Two months before her decease, aching pains were felt in the right thigh, succeeded by the appearance of a small swelling of the femur at its middle part, and seemingly of the bone itself; this increased and had attained the size and ovoid shape of a cocoa-nut before death. Three weeks previous to this event, exophthalmos of the right eye began to show itself, with epiphora and entire loss of sight; but vision was recovered in a few days, the other symptoms continuing.

In removing the body from the ward, the right thigh broke at the seat of the tumour. On turning back the integuments and muscles from the swelling, its surface, which was uniform and smooth, was found to be formed of thickened periosteum, raised and distended all round the bone. Between the latter and the periosteum was the substance of the tumour, formed of medullary matter interspersed with numerous narrow thin plates of bone. A layer of medullary matter three quarters of an inch thick, attached to the inner surface of the periosteum, was white and firm; the rest or interior of a softer consistence, reddish and mixed with bloody fluid.

The bony plates proceeded from the outer surface of the femur in a radiated manner, and this outer surface was roughened and absorbed. The cortex of the bone thus diminished in thickness, was not expanded, and the medullary canal, though containing some carcinomatous deposit, was not at all enlarged. A similar disease existed on both sides of the right ilium, between the periosteum and bone,

on its inner or pelvic side, and between the periosteum and bone on its outer.

A tumour of corresponding character existed at the bottom of the right orbit. Several others of smaller size were present between the inner surface of the calvarium and dura mater. The same diseased changes were present in the sternum, ribs and vertebræ,—all presenting the common character of medullary matter placed between the raised periosteum or dura mater and the bone, and interspersed with osseous plates or spicula proceeding from the roughened surface of the bone.

The uterus was extensively destroyed, and there was an adjacent and adherent diseased mass in the pelvis. The lumbar glands were enlarged—the ovaries were sound, and there were no deposits in the liver or lungs.

CASE

OF

# EXTENSIVE LACERATION OF THE LIVER,

WITH

## RUPTURE OF THE GALL BLADDER, AND OTHER LESIONS,

CAUSED BY EXTERNAL VIOLENCE; TERMINATING FATALLY ON THE NINTH DAY;

WITH REMARKS.

By WALTER FERGUS, M.D.,

HOUSE SURGEON TO THE STAFFORDSHIRE GENERAL INFIRMARY.

Communicated by R. B. TODD, M.D., F.R.S.

Received Nov. 15th—Read Nov. 23rd, 1847.

William Fisher, æt. 17, a labouring boy, was brought to the Staffordshire General Infirmary, about eight o'clock on the evening of the 28th of March 1846. It was stated that he had been standing on the shaft of a water-cart, assisting in filling it, when the horse moving slowly forward caused him to fall, and one of the wheels of the cart passed over his abdomen, just below the false ribs. He was seen by a surgeon an hour and a half after the occurrence of the accident, who found him complaining of pain in the abdomen, but not of a severe character. His pulse was slightly accelerated, and the amount of shock trifling. He was received into the infirmary four hours after the accident, and he then seemed to suffer very little; no marks of violence could be detected, and pressure on the abdomen did not materially aggravate the pain, which was by no means acute. His bowels had not acted

since the preceding day: half an ounce of castor oil was administered, and warm fomentations were applied to the abdomen.

On being left for the night he was quiet and inclined to sleep, his pulse being 80, and natural in other respects. At three o'clock in the morning he was again seen, and then complained of great pain in his abdomen, increased by pressure. The pulse was small and rapid, and his countenance anxious: he was bled to fourteen ounces, and two grains of calomel with one-third of a grain of opium were ordered to be taken every two hours: he nearly fainted before the vein was closed, and vomited on taking the first pill; the ejected matter consisted of green bilious matter, mingled with mucus. He expressed himself as greatly relieved after vomiting. On Sunday, the 29th, the bowels not having been moved, a turpentine enema was administered, which produced one not very copious evacuation of a perfectly natural colour: his tongue was coated with a white fur, and moist: pain was not complained of excepting when he lay on his back, and pressure made in the epigastric region; this pain was quite relieved on his assuming a sitting or an upright posture.

On Monday, the pain still continuing to a slight extent, twelve leeches were applied, after which the pain entirely ceased. His bowels acted freely, and his tongue began to be cleaner. He appeared quite convalescent, and on Wednesday expressed a desire for something more to eat than the fever diet of the infirmary. On this day he left his bed, and continued in so satisfactory a state of progress towards perfect health, that on Friday mention was made of his returning home; this proposition was not agreed to, on account of a degree of sharpness which remained in the pulse, and an unnatural degree of heat of the surface.

On Friday, soon after noon, he was suddenly seized with extreme pain, and a sense of tightness in the abdomen; in an hour after his seizure the pain extended all over the abdomen, and was increased by pressure; the countenance was full of anxiety; and his pulse was small and extremely rapid:

the symptoms present were those of acute peritonitis, from effusion of foreign matter into the cavity of the abdomen. A number of leeches were at once applied, and calomel and opium were given as at first.

In the evening effusion had evidently commenced, though he said he had felt relief from the application of the leeches; during the night mercurial frictions were used.

On Saturday morning he had become very restless, and found relief in changing his posture every minute; he wished to walk about continually, saying he was easiest when moving. The swelling of the abdomen had increased, and was evidently owing to the presence of fluid in the cavity of the peritoneum.

These symptoms continued, without remission, till Sunday afternoon, about fifty hours after the supervention of the acute attack, and the ninth day after the occurrence of the accident, when he died, retaining his consciousness to the last.

A post-mortem examination was ordered by the coroner: it was performed forty-three hours after death. On cutting through the abdominal parietes there was an immense gush of a dark liquor, having precisely the colour and odour of bile; in fact, it appeared only to differ from that fluid in being more liquid. On laying open the cavity, the intestines were found roughened, as in the first stage of acute peritonitis, and some shreds of coagulable lymph were found floating in the dark bilious fluid in the pelvis. The omentum did not cover the small intestines. The liver was seen with a laceration extending in the direction taken by the broad ligament, quite through its substance, and to a depth from the thin edge of two inches and a half; another laceration extended about two-thirds of the length of the convex surface, in a transverse direction; this was of a comparatively slight depth, and was in a state apparently advancing towards reparation. There was no effusion of lymph on the peritoneal surface of the liver, excepting about the lacerations. On raising the free margin of the liver, the omentum was

found rolled up in a mass underneath it, and slightly adherent; it was of a dark dusky colour, and on attempting to unrol it, was perfectly brittle, and gave way under the least pressure; the neighbouring portion of the transverse colon was of the same colour and nearly as fragile. The gall bladder was found ruptured above, but near the junction of the hepatic with the cystic duct, at a spot in immediate relation and in contact with the mass of omentum above described; it was quite empty and contracted. On removing the liver, a large spot of ecchymosis was found on its under surface, nearly corresponding to the rounded sides of the bodies of the vertebræ: when cut through it was found filled with semi-coagulated blood.

A transverse section of the liver being made, a portion of it, about three inches wide, running quite through it, was found very red and denser than the surrounding hepatic tissue: the anterior termination of this red band was in the laceration first mentioned.

The right kidney was found enveloped in its usual fatty investment, which was infiltrated with blood. None of the other abdominal viscera seemed to have suffered violence. On the left side there were marks of effusion of blood, and ecchymosis about the diaphragm, and on the pericardium. Both lungs and the heart were perfectly healthy, excepting that the lower tip of the left lung was brittle and full of serum.

CASE

OF

# LARYNGITIS,

ACCOMPANIED BY

## THE FORMATION OF A FALSE MEMBRANE IN THE TRACHEA AND BRONCHI,

## IN WHICH THE OPERATION OF TRACHEOTOMY WAS PERFORMED.

By T. A. BARKER, M.D.,

PHYSICIAN TO ST. THOMAS'S HOSPITAL, AND LECTURER ON THE PRACTICE OF MEDICINE.

Received Nov. 23rd—Read Dec. 14th, 1847.

M. A. B., ætat. 22, a single woman, of irregular habits, five months advanced in pregnancy, came under my care, in St. Thomas's Hospital, on the 5th of January 1847.

After three months of delicate health, she had been suddenly attacked, nine months before her admission into the hospital, with slight febrile symptoms, accompanied by cough, tightness across the chest, hoarseness, and loss of voice. These symptoms were rather severe for a few days, and then declined, but had never ceased altogether. There had been no difficulty of deglutition during the first six months of her illness, but she had suffered, more or less, from that symptom for the last three months: latterly, however, it had been very slight. From the first there had been pain between the shoulder blades. She had been losing flesh for many months, and the emaciation, slight at first, had lately been rapid.

When admitted into the hospital her voice was hoarse, and she could scarcely speak above a whisper. The larynx was slightly tender on pressure, and she complained of a little difficulty and pain in deglutition; but as there was much nervous excitement, disposition to hysteria, and tenderness on pressure of almost every part of the body, it was impossible to determine how far these symptoms were dependent on chronic inflammation of the larynx. The fauces were red, but not swollen. The tongue was white, the skin moist, the bowels costive, the appetite bad, the pulse small and feeble.

The chest expanded well at each inspiration: and there was equal resonance on percussing the corresponding parts on either side. Beneath each clavicle the respiratory murmur was very loud and harsh; and, on the right side, it was almost as loud and harsh during expiration as during inspiration. There was constant cough, with copious frothy expectoration.

I believed the case to be phthisis, in its earliest stage, commencing on the right side. For reasons already stated, it did not appear certain that the larynx was affected; the patient's own account leading me to suppose that any disease, which might have existed in this organ, had declined or ceased altogether, and that, at all events, any existing disease was very slight and not progressing. Under these circumstances, I ordered sulphate of iron and quinine, and during two days the patient was better: but, on the 7th, the hoarseness, difficulty of deglutition, and tenderness of the larynx, having increased, these medicines were discontinued; a small blister was applied under the angle of each jaw; and iodide of potassium was ordered. These measures relieved her greatly. Slight bronchitis supervened in two days, but disappeared under the use of small doses of tartar emetic; and, on the 13th, she appeared much better in all respects than when she was admitted into the hospital.

On the 14th, the tenderness of the larynx having again increased suddenly, blisters were applied in the same situation

as before. She passed a restless night; and, on the following morning, as soon as I entered the ward, it was evident to me that an unfavourable change had taken place. The inspirations were long, stridulous, and consisted of a series of convulsive efforts; the cough was harsh, shrill, and abortive; and the voice was almost lost. The shoulders were raised, and the efforts at each inspiration were violent. The countenance was anxious, the face flushed, the lips livid, and the veins of the neck distended. There was copious expectoration of tenacious, frothy mucus. The chest was perfectly resonant on percussion, but no breath-sounds could be heard when the ear was applied to the chest.

I immediately decided upon having the trachea opened; and the operation was performed by Mr. Benjamin Travers, jun. The patient's neck being thin and long, no difficulty was anticipated in the performance of the operation; but the necessity of keeping her in an almost erect position, the constant and rapid movements of the larynx, and profuse hæmorrhage from the distended veins of the neck, were obstacles which rendered the operation long and difficult. The cricoid cartilage was divided, vertically, in the mesial line, and the uppermost ring of the trachea was also cut. No relief was given by the simple incision which had been made; and prolonging the incision, cutting out a portion of the trachea, keeping the edges of the wound separated by forceps, &c., only increased the distress of the patient. The veins of the face and neck became very turgid; the face was blanched, the mouth gaping, the pulse imperceptible; the efforts at inspiration, which had been most violent, though abortive, ceased altogether, and she was apparently dead. Mr. Mackmurdo now introduced his finger into the orifice, rapidly passing it upwards and downwards; at the same moment cold water was dashed in the face; a deep inspiration was made, and with the succeeding expiration a large clot of blood was forced out of the wound.

The respiration through the wound immediately became

quite free, and in the course of a few minutes she was completely restored; the countenance resumed its natural appearance, and, with the exception of exhaustion, she made no complaint.

Mixed with the blood, which was forced through the opening at the first expiration, was a whitish, tubular, membranous matter, about three-quarters of an inch long, and large enough to surround the little finger. It had all the appearance of fibrin; and was found to consist of minutely granular matter, with some appearance of fibres.

I think it probable, that this piece of fibrin had been formed in the larynx, at the point where the incision was made; that it had been pushed downwards by the knife, when the opening was made in the trachea; and that, together with the small quantity of blood which entered the trachea through the wound, it had blocked up the tube, until the passage was cleared by Mr. Mackmurdo. For four days after the operation she was much easier. She breathed freely through the opening, which it was necessary to clear of mucus frequently, as the secretion was tenacious, and she was unable to cough with sufficient force to expel it. The chest remained resonant on percussion, in every part; but no respiratory murmur, rhonchus, sibilus, or crackling, could be heard. Indeed, on applying the ear to the chest, it might have been supposed that no air entered the lungs. Believing that this absence of breath-sounds, whilst the chest was perfectly resonant, and freely expanded at each inspiration, depended on fibrinous exudation formed in, and adherent to, the bronchial membrane, I ordered five grains of hydrargyrum cum cretâ every four hours; and one drachm of unguentum hydrargyri fortius to be rubbed in each axilla twice daily. She was allowed light nourishing diet, and a glass of wine.

On the 19th, four days after the operation, the breathing suddenly became embarrassed, and blood issued from the wound in such quantity as to threaten death by suffocation.

She appeared, a second time, to have ceased to exist; when Mr. Travers, who had been sent for on the occurrence of the bleeding, cleared all obstruction from the opening and trachea, dashed cold water in her face, applied stimulating friction to the chest, and, by these means, succeeded in once more snatching his patient from the brink of death. On examining the matters which had been removed from the trachea, one portion, when unravelled, appeared to be a fibrinous cast of the bronchial tubes. It was arborescent, dividing and subdividing, like the bronchi; the largest part was about the size of a crow's quill, and the smallest was not more than half a line thick.

The next day the gums were rather sore: she again expectorated some shreddy fibrinous matter, which was neither tubular nor arborescent.

She now suffered from exhaustion,—caused by loss of blood, insufficient nourishment, the constant fatigue of having tenacious secretion removed from the orifice, and want of sleep. She could swallow without much difficulty, but had no appetite; and a trachea tube caused so much irritation, that it could not be worn. On the nights of the 22nd and 23rd, an opiate was given, which procured refreshing sleep. On the 24th, eight ounces of blood were lost from the wound, but there was no danger of suffocation. Acetate of lead was given, and no great hæmorrhage took place afterwards.

On the day when this second hæmorrhage occurred, the chest was again examined carefully, and it was then found that the breath-sounds could be heard everywhere except in the lower lobe of the right lung, where they were inaudible; and over the same part there was little resonance on percussion. The left side of the chest appeared tolerably healthy; but at the upper part of the right lung, the respiratory murmurs, both on inspiration and expiration, had become much harsher than when they were last heard, and, in some places, there was more dulness on percussion than at the corresponding parts of the left side.

It may here be noticed, that before the mercury (which

was gradually diminished, and in a few days afterwards omitted altogether) was discontinued, the lower part of the right lung appeared to have become almost as permeable by air as the left. From this I infer that it had been rendered solid either by blood gravitating to that part, or by inflammation, and that the blood or fibrin had been absorbed subsequently. On the 5th of February, she had an attack of bronchitis, which was relieved by antimony.

By the 15th, the orifice in the neck, which had been gradually closing, was scarcely perceptible, and she had for some days breathed and expectorated by the mouth. On the 18th, the opening had entirely closed, and the voice, though only a hoarse whisper, was distinct. From this period, there was not at any time the slightest impediment to the free passage of air through the larynx and trachea; and, for a few days, she appeared better, and more comfortable. She soon, however, became worse; the cough was constant and harrassing, the expectoration copious; her nights were restless; her appetite was almost lost, and the little nourishment taken was not retained on the stomach. On February 28th, after a very restless night, she died from exhaustion; the breathing remaining free to the last moment.

*Examination, post-mortem.*—The whole of the mucous membrane of the larynx, and of the upper rings of the trachea, was destroyed by ulceration; the parts were not thickened or swollen, and the passage for air was not in any part contracted. Although the external wound was closed, the incision through the cartilages had not healed. The bronchial membrane was red; but not the slightest trace of fibrinous exudation could be discovered in any part of the tubes. The lungs were crepitant, and slightly congested at the posterior part.

The right lung, especially in the upper lobe, contained many clusters of tubercles; and the lung, between the tubercles, was hepatized, so as to form numerous solid masses, varying in size from a hazel nut to a pigeon's egg. The left

lung was similarly diseased, but to a much less extent; the clusters of tubercles being smaller and less numerous. The liver was rather large, and the hepatic vein was congested. The other viscera were healthy.

*Remarks.* — Although this case terminated fatally, the *operation of tracheotomy* can scarcely be said to have been unsuccessful, when it is considered that the patient survived six weeks, whilst, without the operation, she must have died in less than the same number of hours; and that death, when it did take place, was neither brought about, directly or indirectly, nor in any way hastened, by the opening made in the trachea.

So many successful cases of tracheotomy have been recorded, that I should not have occupied the time of the Society with that which has been read, if it did not appear to be a good example of the benefit to be expected from the operation, even under apparently unfavourable circumstances, provided it be resorted to at an early period; that is, so soon as it is discovered that an impediment exists to the passage of air through the larynx sufficient to cause the circulation of venous blood in the arterial system.

In the case now under consideration, it is evident, notwithstanding the distressing nature of the symptoms, immediately prior to the operation, that the poisoning of the system by venous blood had not proceeded to any great extent; since all appearances of such being the case disappeared very speedily after the air was able to enter the trachea through the opening made in that tube. But, with this single exception, all other circumstances appeared to be most unfavourable, as regarded the success of the operation. The opening was made in a part of the trachea which was probably ulcerated at the time of the operation; and from that, or some other cause, the mucous membrane was in such a state that the irritation of a tube

could not be borne for a moment, — a most unfortunate circumstance, both at the time of the operation and during the progress of the case. The ulceration of the larynx and trachea was also complicated with the effusion of a false membrane at the place where the opening was made; and it is highly probable that, at the same time, there was extensive effusion of fibrin in the bronchial tubes. I consider myself justified in assuming that this fibrinous exudation existed at the time of the operation; since it would otherwise be impossible to account for the entire absence of respiratory sounds in the chest, when there was good resonance on percussion, the day after the operation; and the opinion which I then expressed respecting the cause of this phenomenon was confirmed, a few days afterwards, by the expectoration of a large quantity of fibrin which undoubtedly came from the bronchi. The copious hæmorrhage which took place a few days after the operation; the existence of tubercles in the lungs, though only in early stages, and in small quantity; and the great mental depression under which the patient laboured, arising from causes unconnected with her disease,—were circumstances tending to lessen the chance of life being prolonged for six weeks.

As it was almost certain that tubercles existed in the lungs, and the severe affection of the larynx, demanding an operation, supervened on chronic disease of long standing, I should probably not have given mercury, after tracheotomy had been performed, had it not been for the proof of a form of inflammation having taken place in the air tubes, which was attended by effusion of fibrin. But such being the character of the inflammatory action, I thought that mercury was calculated to relieve it: or rather, that the use of mercury alone offered much chance of arresting an effusion of fibrin, which might soon have completely blocked up the bronchial tubes, and of promoting the discharge of what had been already poured out. The improvement which took place as soon as the mouth was affected was very marked:—the

expectoration became much less tenacious, and the air began to pass more freely into the substance of the lungs.

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*Note.*—I have made no observations on the operation, or on the place at which the opening in the trachea was made, because my friend Mr. Travers, who performed the operation, was so unwell at the time when this paper was written, as to be unable to furnish me with any account of the part he took in the management of the case.

NOTE IN REFERENCE TO A CASE

OF

# MALFORMATION OF THE HEART.

By T. B. PEACOCK, M.D.

Received Dec. 7th—Read Dec. 14th, 1847.

In the report of a case of malformation of the heart, read before the Society in the last session, and published in the Transactions, I remarked that another case, from the similarity of the physical signs presented, probably of a similar description, was then under my care. Unexpected circumstances have since enabled me to test the accuracy of this opinion, and I venture to lay the result before the Society.

A female child, aged five years, was brought under my notice on the 26th of December 1846. She was stated to have been very livid at birth, but acquired a more natural colour soon afterwards, and was stout and healthy till between two and three years of age, when she began to suffer from difficulty of breathing without any assignable cause, had a slight cough, and became thinner. She had since that period been always delicate, and very susceptible to cold; and, when chilled or suffering from catarrhal affection, she became livid in the face, and had hurried and difficult breathing.

She was repeatedly seen and examined in the course of the last year. During this time the cheeks were tumid, much flushed, and with the vessels distinctly visible. The arms and hands were puffy, and the fingers and toes club-shaped at their extremities, and of a deep-red or purple colour, but not blue. The pulse was always more or less accelerated; there was some difficulty of breathing and a slight

hacking cough. The dull space at the præcordia was somewhat greater than natural, but the chest was elsewhere fully resonant. Slight sibilant and sonorous râles were heard with the respiration; and over a large portion of the front of the chest a loud systolic murmur was audible. This murmur was thought to be most intense midway between the left nipple and sternum; but it was also very distinct from this point towards the middle of the left clavicle, across the sternum to the right side, and along the whole of the middle and lower part of the sternum. In these situations the diastolic sound was indistinct, but at the upper part of the sternum, and at the point of pulsation of the apex of the heart, the murmur was less intense and prolonged, and the diastolic sound clear. A feeble murmur was audible to the left of the spine in the interscapular region. There was no permanent turgidity or pulsation of the jugulars. The liver was large and the abdomen tumid. In September, the child returned from the sea-side, where she had been for six weeks or two months, greatly improved in general health. The murmur, however, though less intense, was still audible, and the cyanosis equally decided. Soon after this, she took scarlet fever, had severe ulceration of the throat, followed by vomiting of blood in large quantities, and died exhausted in about three weeks.

The body was examined on the 2nd of November. It was much emaciated. There were slight old adhesions at the lower and posterior part of the left lung, and some lobular condensation in both lungs. The smaller bronchial tubes contained a little secretion, but the mucous membrane was not materially reddened. The heart was of natural form. It weighed three ounces and three-quarters (avoirdupois). There was a slight deposit of fat on the surface of the right ventricle, and some old adhesions between the aorta and pulmonary artery. The right auricle was large and distended with imperfectly coagulated blood. The foramen ovale was completely closed. The right auriculo-ventricular aperture admitted a ball measuring in circumference thirty-nine French

lines:* the valves were natural. In the cavity of the right ventricle there existed a septum, dividing the sinus from the infundibular portion; and this septum was perforated by an oval aperture twenty-one lines in circumference, by which the two divisions of the cavity communicated. The edges of the aperture were smooth, and the lining membrane and muscular structure around had undergone the fibro-cartilaginous transformation on the auricular side. The walls of the sinus of the ventricle had an average thickness of two lines; those of the infundibular portion, of only one line. The pulmonary orifice had a circumference of twenty-six and a half lines. Its valves were natural, and the ductus arteriosus was occluded. The left cavities were natural, but the auriculo-ventricular aperture and the orifice of the aorta were smaller than the corresponding orifices on the right side. The liver and spleen were large. Both kidneys were extensively diseased; they were large, mottled with purple patches, and very lacerable.

This case corresponded with the one formerly reported to the Society, so far as the abnormal septum was concerned, to an extent which I had by no means anticipated;—but the contraction of the pulmonary orifice, and the deficiency of the interventricular septum, which existed in the earlier case, was absent here, although, from the similarity of the physical signs, I had thought it probable they also would have been found.

Of the cases in which supernumerary septa have been found in the right ventricle (of which this is the seventh recorded example) the present one offers the least complicated deviation from the natural conformation. In this instance also (as in three of those previously related), the absence of contraction at the orifice of the pulmonary artery, or of any other cause of obstruction, to which the hypertrophied condition of the fleshy columns forming the septum can be ascribed, renders it only possible to refer the production of this septum to irregular development of the muscular parietes

[* One French line = ·08881378 English inch.—Ed.]

of the ventricle, and of the fleshy column to which the anterior fold of the tricuspid valve is attached; although this irregularity of development may have been combined with inflammation of the lining membrane occasioning adhesions between these parts.

In malformations of this description, the existence or absence of other irregularities must be regarded as indicating the period of life at which the supernumerary septa, dividing the cavity of the right ventricle, became so completely developed as to occasion obstruction to the flow of blood from the right auricle and sinus of the ventricle into the pulmonary artery. In this instance the absence of any imperfection in the auricular or ventricular septa evinces that no material amount of obstruction could have existed at the period of birth.

In one respect the present case forms a striking contrast to that formerly related. In that instance I remarked upon the slight degree of cyanosis which appeared to have been present so long as no other cause of obstruction existed than the congenital contraction of the pulmonary orifice, notwithstanding the very free intermixture of the venous and arterial currents of blood, which must have taken place throughout life. The case now reported is an instance of the reverse condition; permanent cyanosis, or at least lividity of the face and extremities, having existed to a very marked degree, though the venous blood did not enter at all into the systemic vessels, and the only effect of the peculiar malformation of the heart can have been the production of constant congestion of the venous system. This case tends therefore, no less than the former, to confirm the views of Morgagni and Louis as to the cause of cyanosis.

# CASE

OF

# DESTRUCTIVE OPHTHALMIA,

WITH

## EXTENSIVE SUPPURATION OF THE CELLULAR MEMBRANE,

AND

## SEVERE AFFECTION OF THE KNEE-JOINT,

## OCCURRING AFTER PREMATURE DELIVERY.

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It is presumed that the following case will be particularly worthy of the notice of this Society, whose Transactions contain the most valuable essays on the subject of phlebitis generally, and in which the attention of the profession was first directed, in this country, to the occurrence of certain local diseases in connection with, and probably arising from, inflammation of the veins of the uterus in puerperal women.

In the early part of last spring, I was requested by Mr. Francis Hutchinson, of Farringdon-street, to accompany him to visit Mrs. M——, a lady aged about 40, of spare habit of body, but strong constitution and active mind. She had suffered several previous miscarriages, and had been delivered, on the 7th of March, of a four months' child, which had been for some time dead in the uterus; and it was believed that the system was contaminated by the retention of the decomposed fœtus.

Much serious indisposition and constitutional disturbance preceded and followed the expulsion of the fœtus, and on the second or third day after delivery, the contents of the right orbit became inflamed. We found that the globe was much

more prominent than that of the other eye, and it was apprehended that an abscess might be forming behind the organ. The cornea, which had lost much of its transparency, was nearly concealed by tumefied conjunctiva of a crimson colour, which distended the palpebræ and added materially to their projection. Leeches and belladonna had been applied, and calomel with opium administered, on account of inflammation of the iris and tunics generally. A few scarifications were made into the vascular and swollen conjunctiva with the view of relieving the chemosis.

At this time the patient became weakened by several attacks of uterine hæmorrhage, which was arrested by the secale cornutum and the application of cold lotions. The mercury, which had affected the gums, was consequently discontinued. Quinine was liberally administered with a sustaining diet.

On the 28th of the same month, Dr. Frederic Farre visited the patient, and the following is the account he gives of the affected eye:—"The lids were much swollen and closed: on raising the upper lid, I found considerable redness and chemosis of the conjunctiva, but no suppuration. The cornea was prominent and rather nebulous, so as to obscure the condition of the deeper-seated parts: the following changes, however, were sufficiently apparent,—the anterior chamber was greatly enlarged, the iris was yellow and disorganised from effused lymph, and, inclining backwards, adhered to the capsule of the lens; the pupil was also filled with the same effusion; vision was entirely gone. Considering the eye to be irremediably lost, I advised the whole treatment to be directed to sustain the system and repress the uterine hæmorrhage, which had returned and was producing great exhaustion; the quinine was therefore continued with a larger quantity of sulphuric acid." In the mean time the right lower extremity became stiff and swollen, pitting on pressure, and accompanied by œdema of the foot and labium of that side.

Collections of matter were also formed in different parts of the limb, at first principally in the vicinity of the knee-joint and under the integument of the back of each forearm above

the wrist; that on the left arm was dispersed by the application of blisters; the other subsided spontaneously.

The calf of the leg also became swollen and tense, and fluctuation having been discovered, a large quantity of thick pus was evacuated by an incision. The abscesses about the knee-joint and others in different parts of the limb were opened immediately on being detected; their contents consisted generally of well-formed pus; the integuments were not materially discoloured.

It was evident that the cellular, adipose and intermuscular tissues were, at the same time, everywhere loaded with seropurulent infiltration, presenting, when divided with the knife, a greenish grey colour. The mouth and tongue were covered with aphthæ, which were treated with a weak solution of nitrite of silver and with borate of soda. On the 12th of April, the right knee-joint had become the seat of painful swelling from effusion into its cavity, and its several structures suffered from the effects of the most destructive inflammation. A grating sensation was communicated to the hand when the articular ends of the bones were made to move upon each other, from the probable erosion of the cartilages; and the facility with which the articular surfaces could be subluxated in any direction plainly showed the extent to which the ligaments had given way. An abscess was opened on the outer side of the joint, and on the 22nd of April Mr. Aston Key opened another above the internal condyle. Mr. Key expressed his approval of the treatment which was adopted, but had little hopes of her ultimate recovery.

May 23rd.—The condition of the patient had now become most deplorable: she was reduced to extreme weakness and emaciation. In addition to her other ailments, she had cough and diarrhœa, and the integuments over the sacrum, and in other parts subject to pressure, became tender. It was suggested that she should be placed upon Dr. Arnott's water-bed, and it proved, throughout the remainder of the treatment, of the greatest service; indeed, much of the permanent benefit must be attributed to its employment.

The knee-joint, which was considerably bent, had been previously supported, and all motion effectually prevented, by the application of firm pasteboard splints, (the outer one of considerable length,) accurately moulded to the limb. The leg, in which so much suppuration had taken place, was supported by a roller, which served to prevent the burrowing of the matter.

After having been some little time on the hydrostatic bed, from which most essential advantage and comfort were immediately felt, it was ascertained that, in consequence of the pelvis having sunk much below the level of the knee, a very considerable accumulation of matter had taken place, so as to form a projecting tumour at the upper part of the thigh, and it being absolutely necessary, notwithstanding its depth amongst important parts, that it should be evacuated, and that a ready outlet should be given to all fresh collection, it was judged proper to make an opening in this situation. With this view, a slightly curved director, eleven or twelve inches in length, provided with a small button at the extremity, was introduced gently through one of the fistulous openings above the inner condyle: the instrument passed deeply, and took somewhat the direction of the femoral vessels, and, when fully introduced, the extremity, which was too deep to be felt, was ascertained by measurement to have reached within an inch of Poupart's ligament, and near the situation of the anterior crural nerve. The point of the instrument was reached by a careful dissection, and on dividing the fascia an immense quantity of thick pus was discharged. A roller encircling the lower part of the thigh facilitated the further flow of matter through the aperture, which, from the position of the body already described, was dependent. The patient bore her sufferings with much fortitude, and no fresh formation of abscess took place.

From this time may be dated a gradual and steady improvement—the appetite, and with it the strength, increased. The discharge from the numerous and extensive abscesses diminished; the limb regained more of its proper outline,

and the muscles their tone and power. The knee, still considerably bent and distorted, was in a more quiet condition, and successful efforts to extend it were made from time to time by altering the form of the splints, by which it had been constantly supported.

The eye, reduced to a third of its natural size, had receded to the back of the orbit. The external tunics had not ulcerated. All inflammation in the globe and surrounding structures having ceased, the former was speedily reduced by the action of the absorbents to the same dimensions as if the humours had, as in other cases, escaped by ulceration of the cornea or sclerotica. Much deformity was produced by the consequent collapse and falling in of the palpebræ.

On visiting our patient, after an interval of a few weeks, I was gratified to find that she had been gaining flesh and strength, and was enabled to move about a little upon crutches.

The greatest inconvenience which now remained arose from the pain and irritation and the incessant flow of tears, caused by the inverted eye lashes. This was effectually remedied by the introduction of an artificial eye, to which the condition of the atrophied globe was well adapted.

Mrs. M—— is now strong and well; the knee has become almost straight, but nearly anchylosed; and some deformity remains from the subluxation of the articular surfaces of the bones,—the tibia being thrown a little outwards, causing the internal condyle of the femur to project. She can support herself upon the limb, which promises to become a very useful one.

This severe affection of the eye in puerperal women, to which the attention of the profession was first directed by Dr. Marshall Hall and Mr. Higginbottom, and the connection between which and inflammation of the uterine veins was first pointed out by Mr. Arnott and subsequently confirmed by Dr. Robert Lee, must, fortunately, be regarded as an uncommon disease, if compared with the other secondary

effects of uterine phlebitis. In the elaborate and instructive tabular view of 160 cases of uterine phlebitis and its effects, published by the latter gentleman, it appears that, out of this number, there is only one instance of consecutive ophthalmia.

In the detail of the case under consideration, the features of which are so extremely marked and characteristic, it is stated that the affection of the eye preceded that of the cellular membrane and knee-joint. It agrees, in most respects, with the cases above alluded to, in the swelling of the lids, the chemosis of the conjunctiva and opacity of the cornea, the formation of pus in various parts of the body, and the extreme exhaustion of the system; but differs from them, Dr. Farre observes, in the absence of suppuration and of ulcerative inflammation of the external tunics of the eye, and in the more decided inflammation of the deeper-seated parts.

Dr. Robert Lee has subsequently favoured the Society with the particulars of three additional cases of this terrible form of ophthalmia, which are recorded in the Twenty-eighth Volume of its Transactions. There it would appear, as in the case now described, that vision was lost in consequence of inflammation of the deeper-seated parts of the globe without suppuration or ulceration of the external tunics. In these, and in all the cases of this formidable disease before alluded to, the results were fatal.

The affection of the joints, which has been more frequently met with, appears to have been attended with almost equally fatal consequences. Mr. Arnott, in his valuable essay on the subject of phlebitis generally, states that Dr. Merriman had not witnessed a single case of recovery amongst the cases of diseased joints that he had seen in puerperal women. It will be remembered to what an extent some of the component structures of the knee-joint had suffered in the case before the Society.

I may be permitted to observe, in conclusion, that I have met with no other instance of recovery having taken place after such severe consequences of uterine phlebitis.

# TWO CASES

IN WHICH

# THE SKIN, HAIR AND TEETH

## WERE VERY IMPERFECTLY DEVELOPED.

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In the same work in which the founder of Inductive Science noted the "deficiencies of medicine," he likewise complained that he could find "no sufficient or competent collection of the heteroclites or irregulars of nature well examined and described." * Since the days of Lord Bacon, and particularly of later years, much has been done for the advancement of that department of physiology which refers to original defects of structure and malformations; but, notwithstanding the labours of the St. Hilaires and Vroliks of our times, it must still be admitted that the modern-named science of Teratology requires large additions of correctly-observed and well-described facts for its complete development. I shall probably not overrate the importance of this class of facts, when I express the opinion that practical medicine itself, no less than the natural history of our species, may hope to receive additions from the study of these exceptional cases of original structure and function. Hence I think that the cases which I propose now to describe are not merely

* Advancement of Learning.

interesting as medical curiosities, but are calculated to throw some light on the structure and functions of the skin and its appendages.

*Case* 1.—The gentleman who was the subject of this case, died during the year 1847, aged about 58. He was distinguished, throughout life, by the almost complete absence of hair; by the teeth being not more than four in number; by the delicate structure of the skin; and by the absence of sensible perspiration and tears.

During the last ten years of his life, he was more particularly known to myself. At that period he may be described as a person of middle stature, delicate form, and, generally, of a somewhat valetudinarian appearance. His countenance had a rather foreign aspect, difficult to describe; the features being rather small and flat, the nostrils small and compressed, the complexion yellow and freckled, and the face much marked, as if by the small-pox, from which, however, it does not appear that he had ever suffered. Possessed of average intellectual powers, his character was marked by a certain amount of sensitiveness and timidity, and by occasional irritability of temper. These peculiarities of mental constitution may have been in part induced by the physical defects under which he laboured: but, in connection with this subject, it should perhaps be stated that a sister, an uncle and a cousin on the father's side died insane. His habits of life were regular and temperate. He was never married.

On his head, there was not so much hair as on that of an infant three months old. What hair there was, was confined to the crown and back of the head, was very fine, short and soft, and of a light brown colour. The hair of the eyebrows was absent, and the eye-lashes were defective. The hair of the face and chin was relatively more developed than that of the head; but though he practised shaving daily, the beard and whiskers, particularly the latter, were very scanty. In the armpits, there was a small amount

of soft, downy hair; and on the pubes were a few scattered hairs, which were longer and stronger than any others on the body. Elsewhere, indeed, scarcely a hair, however small, was to be observed.

He had only four teeth, which were in the upper jaw, and consisted of the second and third molars of each side. So far as I can learn from the dentist who supplied his deficiency in this respect, there was no peculiarity of any kind in these teeth. I have not been able to ascertain the age at which these teeth appeared, nor yet whether any of the deciduous teeth were ever developed: it is thought they were not. The nasal passages were remarkably narrow, and it was only by extraordinary attention to cleanliness, in drawing water through the nostrils, that he was able to prevent their being completely occluded with mucus. Another peculiarity, of which I was not informed until some time after his death, was, that he had never been known to shed tears, and that the painful emotions, generally relieved in this way, had in him an unusually distressing appearance.

The skin generally was very fine and thin, and very delicate, both as regards colour and texture; as much so, indeed, as in the most delicate female. The surface of the body was often dry and harsh, and exhibited no traces of sensible perspiration: it was remarkably free from any trace of unctuosity. During hot weather, and after taking unusual exercise, the skin often became very hot and red, without being in the least degree bedewed with moisture. Under these circumstances, it was frequently observed that his breathing was oppressed; and, whilst thus heated, he often resorted to the free ablution of the entire surface with cold water, from which he appeared to derive great relief. The only occasion on which his nearest connections or medical attendant ever observed any trace of moisture on the surface of the body, was during the last week or ten days of his life, when in a very exhausted state, and particularly during the hour immediately preceding death.

Sudorific remedies had no sensible effect on the skin, as

regards moisture; but, under their use, changes from a dry and harsh, to a comparatively relaxed and soft, state were observed.

In connection with this part of the case, I am indebted to his medical attendant for the information that he had been long subject to transient attacks of what may be described as feverish heat and excitement. During these attacks, the skin became harsh, dry and intensely hot; the tongue, dry and red, but not coated; the pulse, full and quick; the respiration, difficult and laboured; and his feelings, those of great restlessness and discomfort. These paroxysms were most effectually relieved by small and repeated doses of tartarised antimony, which, in the course of a few hours, produced a state of comparative comfort and tranquillity, the skin regaining its natural temperature and becoming soft and relaxed. Both in health and during indisposition, the urinary secretion was very abundant and usually clear. He had a considerable bronchocele, though this was not so large as to attract much attention during life when covered with the cravat.

He had never enjoyed very robust health, and, about his 35th year, suffered from a severe attack of pulmonary inflammation, which does not appear to have been treated with sufficient activity. After this, he was more or less subject to difficult breathing, which was liable to be aggravated by cold and damp weather. During the last ten years also of his life, he suffered several times from symptoms of severe affection of the stomach, which were chiefly characterised by severe pain, without vomiting, and were relieved by medical treatment.

In the autumn of 1845, he had an unusually severe pulmonary attack, attended with much dyspnœa, cough and debility, and with repeated sanguineous expectoration. He rallied for a while during the warm summer of 1846, but the disease made steady progress during the winter, and he died March 1847.

*Inspection twenty-four hours post mortem.*—Many of the

peculiarities of the tegumentary system already described were now particularly noted. The body generally was much emaciated.

*Head.*—The calvaria was thick, and of almost ivory-like density. The dura mater adhered firmly to the cranium. The internal Pacchionian glands were rather large and numerous, and around them there was a considerable patch of opacity, with trifling adhesion of the arachnoid. The consistence of the brain was perhaps hardly so firm as normal. The blood-vessels were not more loaded than in health. In the lateral ventricles there was about an ounce of serum. The weight of the brain was 49½ ounces; of the cerebrum, 44 ounces; of the cerebellum and medulla oblongata, 5½ ounces.

*Thorax, &c.*—In the left lobe of the enlarged thyroid gland was much calcareous deposit, of a spicular kind. The upper three fourths of the trachea were compressed between the lobes of the enlarged gland, and its area was reduced by about one-half. The mucous membrane of the larynx and trachea was pale and thin, covered by muco-purulent secretion, and studded with minute miliary tubercles. There were old, firm adhesions of the pleura. Two or three vomicæ, surrounded by scattered tubercles, existed in the upper portions of both lungs. In the apex of the left lung was a cavity, the size of a large orange, containing a grumous fluid, resembling the lees of red wine. There were œdema and congestion of the lungs generally. The pericardium contained nearly 4 ounces of turbid serum. The heart was soft and flabby, and weighed 9¾ ounces.

*Abdomen.*—Two ulcers were found in the stomach; the smaller and more recent, in the lesser curvature; the other, the size of a shilling, about an inch and a half lower, in the anterior surface. This ulcer had round, smooth edges, and had completely perforated the mucous membrane. At the point corresponding to it externally, the peritoneum was adherent. Around the cæcum were old, general adhesions of the peritoneum. The vermiform appendage was at least

double the usual length, and was turned up between the cæcum and spine. The liver and spleen were of normal size. The pancreas was large. The kidneys were larger than usual, and healthy. The ensiform cartilage was bifurcated.

It appeared desirable that the microscopic character of the skin should be correctly ascertained and described. I, therefore, transmitted small portions from the axilla, epigastrium and pubes to Mr. Erasmus Wilson, who has favoured me with the following observations, as the results of his repeated careful examination :—

"The peculiarities of the portions of skin sent to me are their whiteness, thinness and softness, and the tenuity of, and absence of pigment in, the epiderma. The number of pores upon the surface and the grooves of motion are natural, though probably smaller than usual. The chief peculiarity, however, is that which is discerned by the microscope,—namely, a state of extreme laxity and apparent atrophy of the derma, with a total absence of fat and of the usual filling-up material. The corium has the appearance of a delicate sponge, every areolar space being transparent and filled with a colourless fluid, and the parietes of the spaces formed of distinct and separate filaments of fibrous tissue. The object which thin sections of the derma most nearly resemble is bone affected with interstitial absorption, all the cell-walls being excessively and beautifully delicate and fine. The sudoriparous glands are not wanting, but their ducts are unusually delicate and deficient in substance, and their epithelial and consequently secreting lining very thin. The portion of skin from the axilla is richly supplied with sebiparous glands, and there is the accustomed cluster of these glands in connection with each hair. The subcutaneous adipose tissue, moreover, has entirely lost its oily matter, that which remains being a mass of shrivelled cells and nuclei, retaining the yellow colouring pigment of fat."

From these observations we may, I think, infer with Mr. Wilson, that the pathological state of the skin in this case

was one of atrophy and atony, and that the absence of sensible perspiration depended, in part, on the defective state of the sudoriparous apparatus; and, in part, on the want of proper action of the skin itself.

I may further state, that Mr. Bowman, who was also good enough to examine portions of the skin with the microscope, did not obtain satisfactory evidence of the presence of sweat-glands or ducts. The result of Mr. Bowman's examination would thus be that of giving a still more defective character to the skin. Mr. Wilson's examination was, however, perhaps more extended, and was repeated on a second set of specimens.

Many curious and not unimportant physiological and pathological questions arise in connection with the case which has now been narrated. Upon these, however, I do not intend to enter at length. I will briefly express the opinion, that the defective structure and function of the skin not only exerted a generally unfavourable influence on the system, but that it, probably, likewise contributed materially to the fatal result. It no doubt rendered the patient less able to resist the chronic disease of the lungs under which he laboured, and which, with a general surface of ordinary transpiring power, might have been more amenable to treatment, or, at least, might have longer remained in a quiescent form. The bronchocele doubtless also acted as an additional cause of pulmonary disturbance.

What appears to constitute a general principle in the laws governing malformations, is likewise illustrated by this case. It will, I think, be found that considerable malformations are seldom single, but are usually associated with one or more minor defects. Thus acephalous fœtuses very commonly present examples of club-foot, supernumerary fingers and toes, and other malformations of the limbs. I have also observed similar malformations to be associated with those defects in cerebral organisation which constitute idiotcy. In the case before us, we may observe that the general teleological defect in the structure of the skin and its appendages

was associated with bifurcation of the ensiform cartilage, and with unusual size and position of the vermiform appendage of the cæcum.

Not being, at the time, informed of the absence of tears in this case, the opportunity was lost for examining the condition of the lachrymal glands and apparatus, supposing them to be present.* It is hardly probable that the gland was present, unless in a merely rudimentary form. And it may be also observed, that the narrow and often occluded condition of the nostrils renders it not improbable that the lachrymal duct was itself absent. In his recent "Report on the Homologies of the Vertebrate Skeleton," and in his "Lectures on Comparative Anatomy," Professor Owen concludes that the lachrymal bone really belongs to a different category from the rest of the bones of the head and face; that it is developed in connection with the skin, and constitutes the solitary bone of the exo-skeleton in man.† Had the absence or defective development of this "muco-dermal" bone been established in the instance before us, the conclusion of Professor Owen as to its homologies would have received valuable and curious confirmation.

*Case* 2.—The circumstance of perhaps most interest in connection with the case which has been narrated, remains to be adverted to. A cousin-german, on the mother's side, who was born only a year or two before the subject of the preceding case, presented almost precisely the same peculiarities. His head was equally bald; the skin had a similarly delicate texture; there was the same absence of sensible perspiration, and of tears, and the teeth were similarly deficient. Which of the teeth were present cannot now be ascertained. His nostrils were more contracted than his cousin's, and were

* I am not aware whether any cases, in which the lachrymal secretion was wanting, have been recorded.

† "Report of British Association for 1846," pp. 210, 300, 308; and "Lectures on Comparative Anatomy of Vertebrate Animals," Part I. 1846. See also "British and For. Med. Review," vol. xxiii. p. 490.

at one time the seat of some ulceration. He had very delicate health, suffered much from inflammatory affections, and died of croup at the age of 13 years.

In early life, the two cousins were almost precise counterparts of each other; and the friends of the family of the youth last described were not a little perplexed when, a year or two after his death, the other came on a visit to his uncle's family. In mental endowments and characteristics, however, there was a great distinction; and whilst the one was timid and sensitive, the other was distinguished for boldness and fearlessness of character, and by his addiction, as a boy, to reading and other intellectual pursuits.

It was only natural to inquire whether similar peculiarities in the cutaneous system had been observed in any former generation of the family. The only approach to such peculiarity, which is known, was in the maternal grandmother, who was distinguished by the extreme delicacy of her skin, and by the very limited amount of sensible perspiration which she presented, under any circumstances. There was, however, no defect or peculiarity in the hair, nor, so far as is known, any in the teeth of this lady; and with the exception of the two grandsons, whose cases have been described, and who were the children of her only two daughters, no such peculiarities have been observed in any of her descendants, who have long reached the fourth generation, and are upwards of thirty in number. For the most part, indeed, an abundance of hair characterizes the family.

The physical defects described in the two cases now related, even when separately considered, must be regarded as rare. As combined, however, in the same individual, and still more as occurring in two persons closely connected by consanguinity, they constitute an anomaly of a still more curious and remarkable kind.

Congenital defect of the hair is, perhaps, less rare than is any considerable deficiency in the teeth. Several of the cases described as congenital have, however, really been examples of loss of hair from disease. Thus, of four cases cited by

Otto, two at least, those of Heister and Wells, are cases of general alopecia.* In his translation of Otto's work, Mr. South briefly alludes to the case (I presume, congenital) of "a man, aged 20 years, employed at the Courier newspaper office (London), in 1841, who had not any hair upon the head, eyebrows, eyelids, or chin, and was said to have had none on the pubes."

Rayer speaks of congenital deficiency of the hair as a malformation very rarely met with. He states that "it very seldom continues longer than the few first years of life, and ought rather to be regarded in the light of a late development of this appendage of the skin." He describes one remarkable case observed by himself in 1827, at the Hospital la Charité, in which this congenital defect was very complete:—"The skin of this man's cranium appeared completely naked; although on examining it narrowly, it was found to be set with a quantity of very fine white and silky hair, similar to the down that covers the scalp of infants; here and there upon the temples there were a few black specks, occasioned by the stumps of several hairs, which the patient had shaved off. The eyebrows were merely indicated by a few fine and very short hairs; the free edges of the eyelids were without cilia, but the bulb of each of these was indicated by a small point. The beard was so thin and weak that Beauvais (this was his name) only clipped it off every three weeks. A few straggling hairs only were observed on the breast and pubic region, as in young people on the approach of puberty. There was scarcely any under the axillæ. It was rather more abundant on the inner part of the legs. The voice had the pitch and intonation of that of a full-grown and well-constituted man. He had had syphilis twice. He stated that his mother and both his sisters had fine heads of hair, whilst his father presented the same defect in regard to the hair which he did himself."†

* Pathological Anatomy, by South, p. 120. The case by Augustin, in Wolfart's Asklepieion, [quoted by Otto,] I have had no opportunity of verifying.

† Diseases of the Skin, by Willis. 1835. p. 1049.

The permanent absence of one, two, or even a greater number of the teeth, is a defect respecting which the dentist will be more frequently consulted than the physician or surgeon, and which is probably not of very rare occurrence. The incisors (of the lower jaw particularly) and the bicuspids, appear to be more especially liable not to be developed.* Mr. Fox mentions an instance in which this defect attached to several members of the same family, none of whom had ever cut the incisors of the lower jaw.

Three cases are recorded in which all the teeth remained wanting through life. The first is that of a woman, sixty years of age, and is recorded by Borelli, who merely observes that the case proves "it is not always true, as has hitherto been believed, that paucity of teeth portends a short or feeble life."†

The next instance which I find recorded is more particularly interesting in connection with the cases which are the subject of this paper, and presents an example of the entire deficiency of both teeth and hair in the persons of two brothers. One cannot but regret the absence of further particulars of these cases, which, though promised by the author who narrates them, do not appear to have been ever given. The brief notice which exists is headed, "Concerning men without hair or teeth;" it is as follows:—"In our neighbourhood lives a Jewish family, of which two adult sons neither have, nor ever have had, hair or teeth. The more particular details are yet unknown to me."‡

The absence in the same cases of both teeth and hair, an associated defect, as we thus find, not now for the first time observed, is confirmatory of the opinion, at the present day entertained by many physiologists, that the teeth, hair, sebaceous follicles and mucous follicles constitute a common class of organs, subsidiary to the integumentary system; and that

* Otto, op. cit., pp. 185, 188. Good's Study of Medicine, vol. i. p. 61.

† Hist. et Obs. Med. Phys. Cent. II. Obs. xli. p. 144. 1676.

‡ Danz, in Stark's Archiv. f. d. Geburtshülfe. Vol. iv. p. 684. Jena, 1792.

they are closely connected in their development, growth and decay.

Cases have been previously recorded in which the sensible perspiration was stated to be entirely absent; but it may be doubted whether they rest on accurate observation.* In the cases which are described in this paper we may regret that no observations on the character and amount of the *insensible* perspiration were made during life.

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*Postscript, July* 14, 1848.—Though such cases as those described in the foregoing paper are no doubt rare, they are probably less so than would generally be supposed. Thus, on the occasion of the paper being read to the Society, Dr. C. J. B. Williams mentioned the case of a young female to which I am happy to refer in this postscript. The young lady was described to Dr. Williams as being without hair and without teeth. When seen by him, however, he found that she was not entirely so. She was fifteen years of age; her hair was fine, scanty and white, and she had scarcely any hair on her eyebrows, or any lashes. She had three or four projections resembling teeth, which were decayed. The nose was imperfectly developed, and she breathed with difficulty through the nostrils. She suffered from chronic ulceration of the lining membrane of the nares, attended by a discharge, having an unpleasant odour. She had great delicacy of constitution and appearance; and her manner was so timid, that she was thought by some to be imbecile. This, however, was the result of a neglected education. Menstruation was not yet established, although there were indications of its approach. She had never perspired. A tonic plan of treatment was resorted to, and under proper care she improved.†

* Good's Study of Medicine, vol. iv. p. 531.

† London Medical Gazette, vol. xli. p. 336.

# OBSERVATIONS

ON

# CERTAIN PATHOLOGICAL CONDITIONS

OF

# THE BLOOD AND URINE

IN

# GOUT, RHEUMATISM AND BRIGHT'S DISEASE.

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In the present paper I purpose to make known some researches on the condition of the blood and urine in gout, rheumatism and Bright's disease, which appear to throw considerable light on their pathology.

The ancients considered *gout* to depend on the presence of some morbid humour in the blood, which, becoming deposited in weak parts, gave rise to the affections of the joints: as to the nature of this matter their ideas greatly varied. At the present time, gout is regarded by some as depending on vascular plethora, by others as due to local debility, accompanied with general plethora; but the balance of opinion appears to be in favour of its arising from some alteration in the circulating fluids. The nature of this change, however, has not been defined, although most agree in regarding it as connected with an excessive formation of uric acid in the system; the frequent presence of chalk-stones or tophaceous deposits in

and around the joints, the liability of gouty patients to uric acid deposits in the urine, and the formation of urinary calculi consisting of the same acid, strongly favouring the idea. But as gout sometimes occurs in patients not having such deposits in their urine, and also in broken-down constitutions not generally considered prone to an excessive formation of uric acid, it has been doubted by many whether this substance is the "materies morbi," or only an occasional accompaniment. Those who look upon gout as depending on a uric acid diathesis, have entertained various views as to the cause of this abnormal state, and the presence of the acid in the blood has hitherto never been proved.

As far as my experiments regarding the nature of this disease have been prosecuted, they appear to show that—

1st. The blood in gout contains *uric acid* in the form of urate of soda, which salt can be obtained from it, in a crystalline state.

2nd. The uric acid is diminished in the urine, immediately before the gouty paroxysm.

3rd. In patients subject to chronic gout with tophaceous deposits, the uric acid is always present in the blood, and deficient in the urine, both absolutely and relatively to the other organic matters, and the chalk-like deposits appear to depend on an action in and around the joints, &c., vicarious of the "uric-acid-excreting" function of the kidneys.

4th. The blood in gout sometimes yields a small portion of urea (no albumen being present in the urine).

The experiments and analyses which favour these conclusions were chiefly made on patients in University College Hospital. In support of the 1st conclusion viz., that *in gout the blood contains uric acid,* the following analyses were performed.

In June 1847, a male patient, R. Hartley, was admitted into the hospital suffering from gout. During the three last years he had been subject to repeated attacks of the disease, and several chalk-stones had formed about the fingers, and a few in other parts. At the time of his admission, many

joints in the right hand were inflamed and swollen, and after a few days new tophaceous deposits began to form. At this time blood was taken from the arm for the purpose of examination. The clot was small, firm, and exhibited upon its surface a buffy coat, about an eighth of an inch in thickness, such as appears in the blood of patients suffering from some slight inflammatory disease. The serum was strongly alkaline. Specific gravity 1028.

1000 grains of the serum were taken for examination, and evaporated to dryness in thin layers in a water-bath. It was then powdered and treated with rectified spirit, boiled for about ten or fifteen minutes, again treated in the same way, and the spirit solutions preserved for examination. After again washing with spirit, the dried serum was exhausted by means of boiling distilled water, the operation being repeated two or three times, and the watery solutions mixed. When a small quantity of this fluid was evaporated with the addition of nitric acid, and afterwards held over the vapour of ammonia, distinct evidence of the existence of uric acid was afforded by the production of the beautiful purple tint of murexide or purpurate of ammonia. The watery solution was then evaporated till it became slightly thick, and, when cool, was acidulated with pure hydrochloric acid. On standing for some hours, crystals of *uric acid* were deposited,* which were afterwards collected, washed with alcohol and weighed.

1000 grains of serum gave of uric acid 0·050 grain.

From another quantity of blood drawn soon after the first, 1000 grains of serum was taken, and treated in the same manner, except that no hydrochloric acid was added. The concentrated watery solution was allowed to stand for some hours, when, on examination, innumerable tufts of crystals were found deposited on the sides of the vessel, and the surface of the fluid. These crystals were proved to consist of urate of soda;† for crystallised uric acid could be produced

* Plate I. fig. 1. † Plate I. fig. 2.

from them, and they left an alkaline ash, soluble in water, and not consisting of potash.

I may remark, that I have always employed this method in seeking for uric acid and urate of soda in the blood.

1000 grains of serum gave of urate of soda 0·050 grain.

But in this experiment some was lost from the solubility of the salt in water, and from its examination previous to weighing.

The next analysis was made on the blood of a man (May), admitted into the hospital, suffering from an attack of gout in the knee; he had for many years been afflicted with this disease, and a small chalky deposit had formed on the cartilage of one ear. When the blood was taken, the attack had begun to subside.

1000 grains of serum gave of uric acid 0·025 grain.

The blood of a male out-patient (Appleby), suffering from an attack of gout of the knees and ankles, was next examined.

1000 grains of serum gave of uric acid 0·045 grain.

The next analysis was performed with the blood of an in-patient (Ansell), admitted for an affection of the heart, with symptoms of angina, who, during his stay in the hospital, had an attack of acute gout in the great toe. Serum, specific gravity 1026.

1000 grains of serum gave of uric acid 0·030 grain.

But much was lost accidentally: it also gave crystals of urate of soda.

I think these cases are sufficient to prove "that *uric acid* is present in the blood in cases of gout," and that "it exists there in the form of urate of soda;" for it was obtained in this form without the serum being acted on by any chemical agent capable of altering the composition of that salt.

2nd. *The uric acid is diminished in the urine immediately before the gouty paroxysm.*—The urine of the patient (Ancell), spoken of above, was carefully examined for uric acid, and

for *several* days at the commencement of the gouty attack, the addition of hydrochloric acid did not cause any deposit of uric acid; although by much evaporation on the third day a trace could be discovered by the murexide test, and a few crystals were deposited. During this time the blood gave abundant evidence of the presence of this body. When the attack had subsided, the *uric acid* was present in the urine in its normal quantity, and could be readily precipitated by means of a strong acid without any previous evaporation. Before leaving the hospital this patient's urine threw down natural deposits of uric acid.

Hartley's urine, when examined during the attack, did not give evidence of containing a trace of uric acid, although a large quantity was evaporated, and carefully examined: the re-action of the urine was very acid.

May's urine was examined when the attack was passing off. Specific gravity 1021; acid.

1000 grains gave of uric acid 0·050 grain.
1000 grains of healthy urine, when of the same specific gravity, yields about 0·60 grain.

So that the uric acid did not amount to more than one-twelfth the normal quantity.

I have examined the urine of other patients suffering from gout, and have found that at the commencement of an attack the amount of uric acid is much below the normal average.

When the affection of the joints has produced excitement in the system, then uric acid and urate of ammonia are frequently thrown out in abundance; especially where an attack of the disease produces, for a time, an improved state of health; but in those persons who have suffered during many years, from repeated attacks, the urine, after the fit, often ceases to be loaded with these matters, and then the disease becomes more frequent in its appearance, and tophaceous deposits are often formed in and about the joints.

3rd. *In patients subject to chronic gout with tophaceous deposits, the uric acid is always present in the blood and defi-*

*cient in the urine, both absolutely and relatively to the other organic matters; and the chalk-like deposits appear to depend on an action in and around the joints, &c., vicarious of the "uric-acid-excreting" function of the kidneys.*—Hartley's blood was examined at other periods, when not suffering from any acute attack, and uric acid was always found in it in considerable quantities. His urine also was always very deficient in uric acid, scarcely ever allowing it to be deposited when a strong acid was added, unless very considerably concentrated by evaporation: the other organic solids, however, were not much deficient, for frequently, on examination, it was found that the amount of urine varied from 40 to 45 oz. while its specific gravity was 1014, and that it contained, of

| | |
|---|---|
| Solids, in the 1000 parts | 31·5 |
| Urea . . . . | 12·5 |
| Other organic compounds | 13·5 |
| Fixed salts . . | 5·5 |

Thus it appears that the kidneys had almost entirely lost their power of excreting uric acid, but not the other solids of the urine.

The uric acid is, however, frequently thrown out of the blood by another process, giving rise to the formation of chalk-stones or gouty concretions. These always contain uric acid; and when first effused appear in the form of a milky fluid, from which the watery portion afterwards is absorbed.

Lehmann gives the following analysis of a deposit on the metacarpus:—

| | |
|---|---|
| Urate of soda . . | 52·12 |
| Urate of lime . . | 1·25 |
| Fixed salts . . . | 14·16 |
| Cellular tissue, water, &c. | 32·47 |
| | 100·00 |

Lehmann found in such deposits innumerable four-sided prisms of urate of soda. But although the analysis of them gives fixed salts, and other matters, yet when first effused they

consist only of a clear fluid containing multitudes of crystals of urate of soda, and it is to the reflections from the surfaces of these crystals that the opacity of the fluid is owing: the phosphate of lime, found in large quantities in some gouty concretions, is probably due to an after deposition from the occurrence of common inflammation around the parts. The appearance, under the microscope, of a drop of fluid effused under the cuticle, in Hartley's case, and of a small quantity of the concentrated watery solution of his serum, was almost identical.* I have examined a great number of these concretions from different parts of the body, and find that all of them consist of bundles of crystals (urate of soda) united into masses. The size of the crystals varies much, apparently depending on the degree of rapidity with which the effusion takes place. Some white matter deposited on the metatarsal bones of a gouty patient, under the microscope, gave evidence of being entirely composed of very minute crystals of this salt.†

It thus appears that sometimes, when the kidneys have lost their power of excreting uric acid, parts in and around the joints, and in other situations, often perform that function vicariously.

4th. *In gout, the blood sometimes contains a little urea (no albumen being present in the urine).*—The alcoholic solution of the serum of Hartley's blood was examined, and found to yield urea. When crystallized with nitric acid,

1000 grains of serum gave of nitrate of urea 0·03 grain.

I have not yet been able to crystallise urea from the blood in other cases of gout, but as it exists in such minute quantities, it may frequently escape detection; perhaps the urea being retained in *small* quantities in the blood, may explain one of the symptoms of gouty inflammation, viz., the frequent presence of slight œdema; since this symptom is so constantly produced when the blood contains a *large* amount of urea, as in cases of Bright's disease.

* Plate I. figs. 2, 3. † Plate I. fig. 4.

Having obtained uric acid from the blood in all cases of gout, I next examined that fluid in other diseases, and also in health. The blood which I selected for the purpose of discovering whether this acid exists in its healthy state, was usually procured from patients suffering from slight headache, or some other very trifling affection, yet of sufficient importance to make them apply for relief.

1000 grains of serum, from such blood, specific gravity 1029, gave of uric acid 0·007 grain.

Again, from the blood of a girl æt. 19, apparently in good health, but complaining of headache,

1000 grains of the serum gave a *trace* of uric acid, but too small to be weighed.

In two cases of patients suffering from slight paralysis, and in an ill-conditioned habit of body,

1000 grains of serum gave of uric acid 0·010 grain.

The blood of the sheep was next examined.

1000 grains of serum gave *no trace* of uric acid,

and this acid forms no part of their urinary secretion.

Afterwards, the blood from the pigeon, whose urine consists entirely of urate of ammonia,* was analysed.

1000 grains of serum gave *no trace* of uric acid.

It appears, then, from these experiments, that in health (or tolerable health), uric acid can be detected in the blood of the human subject; perhaps its quantity may vary with the length of time which has elapsed between taking food and the abstraction of the blood. It also appears, that when the function of excretion is very perfectly performed, no trace can be detected, although, as is the case with birds, the amount of uric acid formed in the system is very large.

The blood in *acute rheumatism* was next examined, for the purpose of seeing the relation between this affection and gout,

* Under the microscope, the urine presents the appearance shown in Plate I. fig. 5.

two diseases which have usually been considered as nearly allied.

The results which I obtained appear to indicate that—

*In rheumatism, the blood contains no more uric acid than in health; and no urea can be detected in* 1000 *grains of serum.*

Many cases were taken to prove this conclusion.

An in-patient (Friend), suffering from acute rheumatism, with most of the large joints affected.

> 1000 grains of serum gave only a trace of uric acid, too small to weigh.

A male patient (Exley), with acute rheumatism. The right wrist inflamed the day before the bleeding; the knee for two or three days previously. A buffy coat on the clot, about one-third of an inch thick.

> 1000 grains of serum gave traces of uric acid, but the quantity too small for weighing.

A male patient (Barret), with acute rheumatism; blood very much buffed, and cupped.

> 1000 grains of serum gave of uric acid a mere trace, too small to weigh.

A girl (Holloway), with acute rheumatism, who had lived low for some time.

> 1000 grains of serum gave no indication of either uric acid or urea.

A male patient (Smith), with acute rheumatism, affecting the knees, ankles, elbows, and wrists: the clot firm, with a buffy coat about three-eighths of an inch thick, and cupped: serum alkaline; specific gravity 1028.

> 1000 grains of serum gave of uric acid numerous crystals, but they could not be collected for weighing.
>
> 1000 grains of serum gave no trace of urea.

This patient had been in good health previous to the attack.

In acute rheumatism there is no evidence of any deficient

"uric-acid-secreting" power in the kidneys, and the urine is also generally loaded with urea.

Blood from patients suffering from *Bright's disease*, and *albuminuria after scarlatina*, was then examined: the results of these analyses appear to show, that—

1st. *Uric acid is always present in the blood in albuminuria. The quantity, however, greatly varies: when the functions of the kidneys are much impaired, it exists in quantities almost as great as in gout; in other cases its amount is small, but it usually exceeds that found in ordinary blood.*

2nd. *Urea always exists in large quantities in this blood, (a fact which has been long since proved,) and no relation is found between the amounts of urea and uric acid.*

3rd. *The kidneys are always deficient in their power of throwing off urea; but with regard to the uric acid, their excreting function may be impaired or not.*

In a male patient, (McCarty,) suffering from albuminuria, with anasarca (an advanced case),

1000 grains of serum gave of uric acid 0·037 grain.

Much urea was contained in the blood.

In a male patient (Peter Skelley), suffering from albuminuria, with anasarca, the disease not being far advanced, œdema of legs not having been noticed more than a few weeks.—Specific gravity of serum 1028.

| | |
|---|---|
| 1000 grains gave of uric acid . . . . | 0·005 grain. |
| 1000 grains gave of urea (nitrate) . . . | 0·192 „ |
| 1000 grains, at another examination, gave of nitrate of urea . . . . . | 0·145 „ |

The urine from this patient usually contained a precipitate consisting of uric acid crystals and the lining of the tubuli; a further quantity of uric acid was precipitated on the addition of a strong acid.

In Richard Cole, a patient with albuminuria and anasarca,

1000 grains of serum (specific gravity 1026) gave of uric acid 0·012 grain.

In Mary Cockburn, æt. 9, with albuminuria after scarlatina,

1000 grains of serum gave of uric acid 0·027 grain.

The blood also contained a large amount of urea. The urine was very albuminous, and the anarsarca considerable.

I may remark, that during the evaporation of the serum of blood in albuminuria, a peculiar *odour* of urine was frequently detected; this was not observed in healthy serum, or in that taken from gouty or rheumatic patients. Some of the *colouring* matter of the urine seemed, however, to be thrown down with the uric acid in all cases.

The results of these experiments on the condition of the blood and urine, prove that uric acid is not a product of the action of the kidneys, as is frequently supposed, but that it is merely excreted from the system by these organs. They also appear to indicate that the excreting function of the kidneys, with regard to the solid portion of the urine, is not simple, but that the urea and uric acid are separately eliminated; also that one of these functions may be impaired or destroyed, the other remaining entire. With regard to the solid and fluid portions of the urine, Mr. Bowman has already shown the probability of different structures in the kidneys being concerned in their excretion.

It appears also probable that as, in albuminuria, the "urea-excreting-function" being chiefly impaired, we find a vicarious discharge of this body in the dropsical effusions; so, in gout, the "uric-acid-excreting function" being defective, the chalk-like deposits are produced, by a similar vicarious discharge of urate of soda.

Gout would thus appear partly to depend on a loss of power (temporary or permanent) of the "uric-acid-excreting function" of the kidneys; the premonitory symptoms, and those also which constitute the paroxysm, arising from an excess of this acid in the blood, and from the effort to expel the "materies morbi" from the system. Any undue *formation* of this compound would favour the occurrence of the disease; and hence the connection between gout and uric acid, gravel and calculi; and hence, the influence of high living, wine, porter, want of exercise, &c., in inducing it.

This hypothesis would also explain two facts which have been regarded as militating against its humoral pathology; viz. the *hereditary* nature of the affection, and also its frequent occurrence in *low states* of the system; for we can understand that the peculiarity of the kidney, with reference to the excretion of uric acid, may be transmitted; and, likewise, that when the function in question is permanently injured, it will not require an excessive *formation* of the acid to cause its accumulation in the blood.

Dr. Todd's observations on what he terms the "gouty kidney," appear to favour this view. This hypothesis would also remove gout from acute rheumatism, for no excess of uric acid was found in the blood in this affection. Again, if we take into consideration the causes of the latter affection and the subjects in whom it occurs, we must be led to consider the two diseases as analogous only as far as they both affect similar structures. What greater analogy exists between gout and rheumatism, than between any two skin diseases?

In conclusion I must beg to express my thanks to Dr. C. J. B. Williams for his kindness in affording me every facility for the prosecution of my researches in patients under his care, and also in communicating this paper to the Society.

The following preparations illustrative of the paper were exhibited when it was read.

1. Uric acid from blood in gout.
2. Urate of soda from blood in gout.
3. Uric acid from blood in health.
4. Uric acid from blood in Bright's disease.
5. Chalk-like deposit from great toe.
6. Pieces of deposits (tophaceous).
7. Deposit on cartilages of tarsal bones.
8. Nitrate of urea from blood in gout.
9. Nitrate of urea from blood in Bright's disease.

*Postscript, July* 26, 1848.—At the discussion which ensued after the reading of the above paper to the Society, some remarks were made which implied that I was understood as considering gout to be entirely dependent on a deficient power in the kidneys for the excretion of uric acid; such, however, is not my opinion: and, at present, I do not wish to advance any hypothesis as to the cause and nature of gout, considering that many further researches should be made on the subject before a theory of the disease could be advanced with safety. The conclusions which I stated were such as seemed to me, at once, to arise from the data given.

The discovery of uric acid in blood, and the finding that its amount is much greater in gouty than in healthy blood, and that the kidneys may temporarily or permanently lose their power of excreting this acid, are facts to my mind important.

With regard to the *weights* which have been given, I may observe that in the earlier determinations they doubtless were below the real quantities, a circumstance which arose from the watery solutions of the serum not being sufficiently concentrated, and from sufficient time not being allowed for the deposition of the uric acid. In the experiments now made, I do not collect the crystals until after forty-eight hours have elapsed. Such slight errors are however unavoidable in new investigations on any subject.

Since the above paper was written, some further experiments have been made.

A young man, æt. 28, died of phthisis. He had suffered from gout for eight years, had many tophaceous deposits upon his hands and feet, some of which had taken place a few days only before his death. The blood used for the analysis was taken a few hours after death.

1000 grains of serum gave of uric acid 0·175 grain;

a greater amount than I had ever obtained.

In some other cases of old standing gout, the patients being afflicted with extensive depositions of chalk-stones, the urine was examined to ascertain the quantity of uric acid.

In one case, a female,

> 1000 grains of urine, specific gravity 1010, gave *no* trace of uric acid, although much evaporated.

In another case, a man,

> 1000 grains of urine gave only 0·02 grain of uric acid.

These results confirm those stated in the paper.

I have also lately many times repeated the analysis for detecting uric acid in healthy blood; and have always succeeded in finding it, even when the individuals were in most perfect health, and were only bled for the purpose of experiment. I have also succeeded in finding *urea* in *perfectly healthy human blood.*

In one case,

> 1500 grains of serum gave of nitrate of urea 0·015 grain.

The detection of urea in healthy human blood will easily explain why it was found in some cases of gout; and, probably, urea may sometimes be retained in the system to a considerable extent, without the existence of any such disease of the kidneys as is made known by the presence of albumen in the urine.

Very lately I have examined the blood of a patient who came to me for an affection which he called gout, but which, for many reasons, viz. the history of the case, the subject of the disease, the parts affected (the side of the foot and hands), I considered to be rheumatism. The serum gave only traces of the presence of uric acid, which could not be weighed. The solution of the blood had also certain peculiarities which I have observed in rheumatism, but not in gout.

Might it not, in doubtful cases, be possible to determine the nature of the affection from an examination of the blood?

Some of the results contained in the paper appear to me to be interesting in a physiological as well as pathological point of view; especially the occurrence of opposite conditions of the blood and urine, as we find—

Fig: 4.
*L. M. P. 670.*

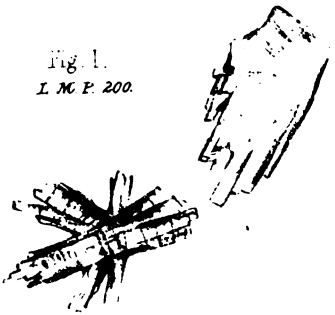

Fig: 1.
*L. M. P. 200.*

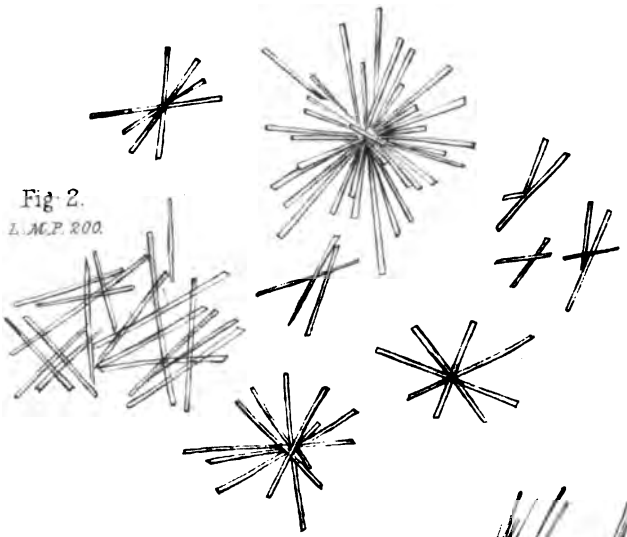

Fig: 2.
*L. M. P. 200.*

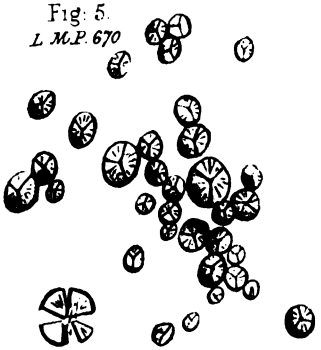

Fig: 5.
*L. M. P. 670*

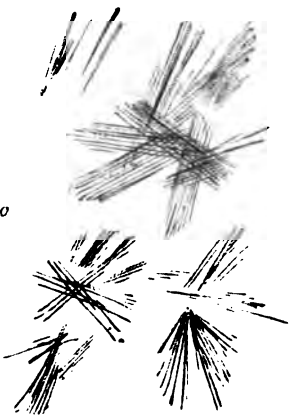

Fig 3.
*L. M. P. 200*

B. George, lith. 54, Lamm Garden.

In certain cases (Bright's disease),

Blood—rich in *urea*, but with little *uric acid*.

Urine—deficient in *urea*, but not so in *uric acid*.

In other cases (gout),

Blood—with little or no increase of *urea*, but rich in *uric acid*.

Urine—with little or no decrease of *urea*, but very deficient in *uric acid*.

At some future time I hope to bring before the Society some further researches on the pathology of uric acid.

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## EXPLANATION OF PLATE I.

Fig. 1. Uric acid from blood.

Fig. 2. Urate of soda deposited from the solution of the watery extract of gouty blood.

Fig. 3. Urate of soda from chalk-stones in gouty subjects.

Fig. 4. Urate of soda deposited on articular cartilage.

Fig. 5. Urine of the pigeon, exhibiting the form in which the urate of ammonia occurs.

ON

# PETIT'S OPERATION

FOR THE RELIEF OF

# STRANGULATED HERNIA.

By JAMES LUKE,

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Communicated by the President.

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It has been remarked that the comparative value of the operation for the relief of strangulated hernia, as recommended by Petit, without opening the hernial sac, must be determined ultimately by an appeal to experience. However true the remark, and however desirable it may be to arrive at just conclusions, many difficulties arise in the course of inquiry, which do not present themselves upon a first view of the subject. Of these, the impossibility of obtaining parallel cases for comparison appears to present an almost insurmountable obstacle to a perfectly satisfactory result.

This difficulty, however, may in great measure be overcome by the comparison of large numbers of cases. But by this mode of proceeding, difficulties of another kind are created, which time and numerous opportunities alone can fully obviate. Cases collected in publications from the separate experience of many surgeons seem wholly insufficient, and are almost worthless unless they embrace the entire of such experience. It must be evident that the selection of cases from amongst others of the same kind, which for various reasons are withheld from publication, must necessarily yield

a false colouring to the experience it is intended they shall represent; and although they may in themselves be true, they do not represent the whole truth, and consequently are extremely unsafe for the purposes of just comparison.

The experience of Petit's operation hitherto published seems wholly to be of this character. The few cases already collected have been culled from many sources, whence it is highly probable that more extensive details might have been furnished, with conclusions more worthy to be considered as the fruits of experience.

In offering the present paper to the Society, I have endeavoured as much as possible to avoid this source of fallacy, by rendering up for its consideration the whole of the experience which I possess upon the subject of which it treats. It will, however, be proper to mention that I have not deemed it necessary to state the result of my experience of the operation for the relief of strangulated hernia as ordinarily performed by opening the hernial sac. Indeed, were I so disposed, I have not at hand the means necessary for the purpose, as some years have elapsed since I abandoned the ordinary operation as an ordinary practice. It will perhaps be sufficient for the purposes of comparison to call attention to a few details of the ordinary operation which have been published from the experience of others, but not open to the objections above stated. From these we learn the serious results and high rates of mortality which have usually followed this common course of proceeding, and are powerfully impressed with an idea of the necessity of seeking means for its diminution.

M. Textor states that, of fifty-six cases of strangulated hernia subjected to operation at Wurtzburg, between 1816 and 1842, twenty-four died, or nearly one-half.

M. Malgaigne states that of 220 cases subjected to operation in the Parisian Hospitals, between 1836 and 1840, 133 died, or considerably more than one-half.

Of fifteen cases of operation published by Mr. South, six died, or one in two-and-a-half.

Of cases published in the British Journals, I some time since ascertained that one-half died.

Of sixty-five cases subjected to the operation of opening the hernial sac, in the London Hospital, twenty-two died, or rather more than one-third of the whole number.

The obvious tendency of such details is to disincline surgeons from undertaking an operation so apparently fatal, until every effort likely to render it unnecessary by a successful taxis has been exhausted. Procrastination and delay is the too common effect. The results of the taxis also favour protracted efforts; and thus, the mortality of the operation, by deterring from its performance, on the one hand,—and successful taxis, by inviting protracted trials, on the other,—lead equally to delay and the loss of much valuable time.

Mr. King states that, of forty patients relieved by taxis, four died.

M. Textor states that, of 114 patients relieved by taxis, nine died.

Of 293 patients admitted into the London Hospital for strangulated hernia, between 1842 and 1847, 206 were relieved by taxis: amongst these patients there is not any death recorded.

We may, therefore, conclude, that when the taxis is performed successfully, the attendant danger to the patient is not very great, and persevering efforts for the attainment of so desirable a result appear to be a natural consequence. Conclusive and legitimate as the inferences appear from the foregoing statement, there are fallacies beneath them which it is desirable should be corrected, lest they encourage a practice more fatal even than that which I have stated as following the ordinary operation when ultimately appealed to.

I am not aware that at present any data exist adequate to remove those fallacies in a perfectly satisfactory manner. To do so, it is necessary that the general mortality of all cases treated by taxis and by operation should be stated conjointly, and a comparison instituted between the practice of protracted attempts to secure a successful taxis, and of

securing an early relief by any means to constricted parts, either by taxis or by operation. It is possible (although I think not probable) that the augmentation of the mortality of the operation, when deferred, is neutralized in the general results by the increased security which a successful taxis yields to the patient, even when protracted, and that what is lost on the one hand is gained on the other in the general average of mortality. There can be little doubt, however, that the mortality succeeding the operation alone is greatly increased by delay in its performance. Thus of sixty-nine patients operated on at the London Hospital or by myself, *before* the expiration of forty-eight hours from the commencement of strangulation, twelve died. Of thirty-eight patients operated on *after* the expiration of forty-eight hours, fifteen died. Of thirteen patients in whom the strangulation was of doubtful duration, six died.

That the operation itself as ordinarily performed, abstractedly from all considerations of visceral lesion by constriction, is in some degree dangerous, must be admitted. That the danger is also increased by the necessary exposure and immediate manipulation of parts so important to life, (especially when already the subject of inflammation,) is likewise true. Thence might partly arise the reluctance to have recourse to operation; and it appears likely that if the taxis could be accomplished even by an operation, without such exposure and manipulation, the reluctance would be in some measure, if not wholly, removed, and an earlier appeal to such operation might generally be expected as the result, provided no new dangers arise from the proceeding.

Such is indeed the scope of Petit's operation, which, by leaving the hernial sac unopened, causes a very close assimilation to the taxis as ordinarily performed; and this has already been shown to be attended by a very moderate amount of danger. The arguments, *à priori*, in favour of Petit's operation have already been stated by Mr. Key, in an excellent memoir on the subject, published some time since. It will consequently be unnecessary to repeat them in a paper in-

tended to embrace merely the results of experience. I am not aware that any series of results have hitherto been placed before the profession which will enable it to compare satisfactorily the value of Petit's operation with that ordinarily pursued by opening the hernial sac. In attempting to supply this deficiency to a limited extent, I do so with the hope that, if the comparison shall prove favourable to the method of operating without opening the sac, the more general adoption of it will follow as a consequence, and that there will be less reluctance to appeal to it at an early period of strangulation.

The materials from which the statements in this paper are drawn have been collected principally since the year 1841, although during the preceding ten years I have occasionally selected cases on which to perform Petit's operation from amongst many others which have fallen under my observation.

Since 1841 I have (with four exceptions) invariably attempted to perform the operation for hernia without opening the sac, a circumstance worthy of notice in this place, because to a certain extent we may conclude from it what will be the general results, both as regards the successful performance and mortality of the operation, provided it be adopted by the profession generally, as it has been by myself, as an ordinary rule of practice.

Inclusive of cases occurring between 1831 and 1841, (which were selected,) I have attempted the performance of Petit's operation in eighty-four cases. Of this number the operation was completed successfully, without opening the sac, in fifty-nine. In twenty-five it was necessary to open the sac to effect a reduction of the hernial contents, the opening generally varying in extent from one-half to one-quarter inch. With respect to the mortality amongst these patients, —of the fifty-nine in whom the sac remained unopened, seven died; of the twenty-five in whom the sac was opened, eight died.

Although it may be expedient thus to state in a general summary the results of all cases subjected to an attempt to perform Petit's operation, yet, for the purpose of satisfactory comparison, those cases which were selected from numerous

others (and which, therefore, may be presumed to yield results more satisfactory than ordinary) should be excluded; as also should those cases be, which from their nature could not be expected to be benefited by an operation of any description, or even by the taxis, could it have been successfully performed. The endeavour which the surgeon makes in such cases is like a forlorn hope, from which little but death is to be anticipated. For the above reasons I propose to exclude the twenty-six selected cases occurring between 1831 and 1841, and also four other cases, three of which were considered moribund at the time of the operation, and two of which died within three hours of its performance. The fourth case is excluded because the patient had recovered from the operation. Death, however, took place about six weeks from the period of its performance, in consequence of effusion into the peritoneal cavity, caused by stricture of the bowel and ulceration of the part which had been previously the subject of strangulation.

Lest it should be considered that these four cases have been improperly excluded, I have deemed it expedient to detail so much of the particulars of each as will enable the reader to restore them to their proper places in the details which are subjoined. They are as follows:—

| No. | Sex. | Age. | Species of hernia. | Duration of strangulation. | Sac opened or not. | Result. | Remarks. |
|---|---|---|---|---|---|---|---|
| 1 | F. | 70 | Right femoral | 48 hours | not opened | died | Effusion into peritoneum. Wound healed. Died 6 weeks after operation. |
| 2 | F. | 56 | Right femoral | 62 hours | not opened | died | Moribund. |
| 3 | F. | 40 | Right femoral | 40 hours | not opened | died | Moribund; lived 3 hrs. |
| 4 | F. | 81 | Left femoral | 72 hors | not opened | died | Moribund; lived about 14 hours, under the use of strong stimulants. |

After subtracting these thirty cases, fifty-four remain, which may be considered as affording satisfactory data upon a limited scale, for comparison with the results of the ordinary operation as previously stated, as well as for showing the amount of success which has attended the attempts made to carry Petit's operation into effect generally, and in each kind of hernia which has been the subject of operation. Of the fifty-four cases, the sac was opened in twenty-one, of which three died; and not opened in thirty-three, of which two died. Thus in upwards of three-fifths of the whole number, Petit's operation was successfully completed. Of the cases in which the sac was opened, in ten the strangulation of the contents had continued before the operation was performed under twenty-four hours, of which one died; in three, under forty-eight hours, of which one died; in eight, above forty-eight hours, of which one died. Of the unopened cases, the strangulation had continued in thirteen under twenty-four hours, of which none died; in twelve under forty-eight hours, of which one died; in eight, above forty-eight hours, of which one died. It should be recollected, whilst comparing these results with each other, as well as with the results of the ordinary operation in which the sac is opened extensively, that in opening the sac in cases of failure, it has not usually been divided beyond a very limited extent, (varying from one-quarter of an inch to one inch and a quarter,) and that consequently the irritation, from exposure of the hernial contents, and from the rough and immediate handling which they too often undergo when already in a condition of high inflammation, is almost wholly avoided. For this reason it may be expected that the results of these cases of limited section of the sac will approximate to the results of Petit's operation, to which they bear a certain resemblance, and that they will bear no very unfavourable contrast to it, although its principle is not so perfectly carried out. It should not be considered that the necessity to open the sac implies either a greater degree of constriction of the hernial contents or a consequently greater severity of case from organic lesion, than

in instances in which no such necessity occurs. It appears that the nature of the structure which causes the constriction, rather than the degree of constriction, however great, is the ordinary source of failure.

Thus, a stricture may be caused either by the neck of a hernial sac, or by the margins of the abdominal aperture, wholly independently of the sac. The degrees of constriction arising from these causes may be equal, and the consequent organic lesion may be in no respect different. Yet, in the former case, the surgeon will most frequently fail in his attempts, and be obliged to open the sac to enable him to return the contents into the abdomen; while in the latter, success will almost invariably attend his endeavours, unless adhesions have occurred within the sac.

Cases, as respect the hernial contents and the degree of constriction which they have suffered, may therefore be quite parallel, but differ widely in the amount of difficulty to be encountered in the performance of Petit's operation; and although failure of success involves a partial exposure of the contents, it does not necessarily imply a greater amount of danger, except that which arises from the opening itself. It is also to be expected that the results of these cases will be more favourable than the results of the ordinary operation, provided exposure and irritation are elements which generally militate against success, for these are (as already stated) almost wholly avoided.

With respect to the causes for opening of the sac in these twenty-one cases, it appears that in three Petit's operation was successfully completed, but the sac was opened after the reduction of the strangulated parts into the abdomen, to remove some doubts as to their perfect liberation. The proceeding in each case, however, was ascertained to have been wholly unnecessary.

In ten the stricture was caused by the neck of the sac.

In one the stricture was at the inner ring.

In one the hernia (femoral) extended to the umbilicus and into the scrotum, the intestine being very greatly dis-

tended by flatus, and having its peritoneal tunic rent by the distention.

In two the opening was accidental.

In four the cause of the sac being opened is not stated.

When an analysis is made of the different kinds of hernia, a great disproportion is found in the amount of success attending the attempts to complete the operation; from which we may infer the difficulties that have been encountered in each respectively, and also what are probable in other cases. Amongst the fifty-four cases, there were thirty-one of femoral, twenty of inguinal, and three of umbilical hernia.

Of the thirty-one cases of femoral hernia, the sac was opened in seven, of which one died; and not opened in twenty-four, of which one died.

Of the twenty cases of inguinal hernia, the sac was opened in thirteen, of which two died; and not opened in seven, amongst which number there was not any death.

Of the three cases of umbilical hernia, the sac was opened in one, followed by recovery; and not opened in two, of which one died.

The foregoing statement demonstrates, that the performance of Petit's operation has been by far most frequently successful in femoral, and that it has been most frequently necessary to open the sac in inguinal hernia, to effect the reduction of its contents into the abdomen. This result is quite in accordance with our expectations, and might have been anticipated from the difficulties to be encountered from the usual seat of stricture in such cases. All surgeons agree that the stricture is occasionally seated in the neck of the hernial sac, but a difference of opinion exists as to its supposed frequency. Those who deny its frequency suppose that the constriction, in many cases, is caused by the fascia which immediately invests the sac. I agree with those, however, who think that the constricting cause is most frequently seated in the neck of the sac, and results from a thickened condition of the peritoneum at that part, the breadth of which varies in different cases. Of the twenty cases of

inguinal hernia enumerated, I find by my register that the seat of stricture is stated to be in the neck of the hernial sac in no less than fifteen. When so seated, it has been mostly found, not at the abdominal apertures, but a little below the external ring, the distance varying from half an inch to an inch. I have, however, seen it as much as three inches, producing the hour-glass contraction of the hernial sac. It is generally supposed, that when the stricture is produced by a thickened state of the peritoneum at the sac's neck, Petit's operation cannot be by any means successfully performed. The supposition is not wholly correct. It is true, that the difficulties of performance are very greatly increased, but they are not insurmountable. In confirmation of which assertion, I find that of the seven cases of inguinal hernia in which Petit's operation was successfully completed, five are stated to have the seat of stricture in the neck of the sac. Before proceeding further, it may be advantageous to describe the mode of proceeding which I have usually adopted in such cases. The first step, before any incision is commenced, is to ascertain the exact spot at which the stricture is situated; for it must be evident that, without such information, the necessary incisions are liable to be directed to a point different from that in which they are really required. This information (as more fully stated in the Medical Gazette, vol. i. 1839-40) is attained through a general knowledge of the fact, that the stricture prevents the communication of impulse from one part of a tumour to another, beyond the stricture. Nothing more, therefore, is required in availing ourselves of that knowledge, than to press the tumour firmly between the fingers of one hand, with a view to cause impulse, while with the fingers of the other hand at the neck of the sac the precise point at which impulse ceases is carefully ascertained. At that point will be found the seat of stricture. Having obtained this information, the next step is, to incise the integuments, so that the centre of the incision shall be directly over the stricture, a proceeding easily accomplished by causing a transverse fold to be pinched up between the fingers, and

divided by transfixing it with a straight bistoury, in a direction parallel with the long axis of the tumour. The various fascias are subsequently divided, until the neck of the hernia is fairly exposed. If this be carefully and completely done, a depression will usually be observed at the seat of stricture, presenting a more contracted appearance at that part than at others. To the touch this contracted part feels thick, and often hard, while into it thin layers of fascia dip, which may be mistaken for the stricture itself, but which may be divided wholly independent of it, and no relief arise from the division. When these layers are turned back, the real stricture is exposed to view. In proceeding further than this point much caution is required. The remaining object to be attained is, to incise, or rather scarify, the exposed and thickened peritoneum (which forms the stricture at the sac's neck) in one, two, or three places, without completely dividing it. By these scarifications, the stricture becomes so weakened, that it is placed in a position most favourable for yielding to the pressure of the taxis, and, consequently, most favourable for its successful attainment, a circumstance which is much assisted by the removal of the support which it previously derived from the surrounding fascias in their entire state. It must be evident that, in thus dealing with a stricture so seated, it is somewhat difficult to limit the incisions so as to avoid its complete division. Should this division happen, an opening is necessarily made into the hernial sac, and the attempt to complete Petit's operation becomes a failure. Yet the opening thus made being of small extent, there is little consequent exposure of the hernial contents. It is often sufficient, however, without further enlargement, to admit the successful application of the taxis, in which case little less than a successful attempt has been attained in the performance.

It has occasionally occurred that the strictured part has been rendered so thin and weak by the scarifications, as to give way under the pressure of the taxis, even when moderate in amount, and the fluid contents of the sac have escaped by the opening, and on one occasion with a small portion of

intestine. In this case, the intestine was readily replaced within the sac, and afterwards reduced into the abdomen by the taxis, without any consequences worthy of note.

When the stricture is caused by the margins of the external ring, the division of it is of easy accomplishment, by introducing the hernia-director beneath, and dividing it with a bistoury. On the contrary, when the stricture is at the internal ring, the division is extremely difficult, in consequence of the depth of its situation. The attempt is to be made after the same manner by the introduction of a director, and by the use of a common bistoury.

For the relief of femoral hernia, Petit's operation has been much more frequently successful than for inguinal. Thus, of thirty-one cases of femoral hernia in which that operation was attempted, it was successfully performed in twenty-four, being more than three-fourths of the whole number.

The rate of mortality has been so low in these cases, that the confidence of surgeons in the mode of operating appears fully justified.

There is great variety in the forms of femoral hernia. In the more common forms the tumour rises over Poupart's ligament, to a greater or less extent, sometimes considerably overlaying the anterior surface of the tendon of the external oblique muscle. It sometimes obscures the external inguinal ring, in which case it becomes liable to be mistaken for inguinal hernia. In other cases it rises to the spine of the ilium or even to the umbilicus; of which I have seen one example. In all such cases the femoral ring is obscured by the tumour, and there is an apparent difficulty in reaching it for the purpose of dividing the stricture without opening the sac. The difficulty in most cases is not real, although it is possible that in some it may form a serious obstacle to the operator's proceedings, or even prove insurmountable.

The operation is generally one of easy performance, and may often be accomplished with a safety and a despatch by no

means commonly to be witnessed in the ordinary operations for hernia.

When the tumour thus rises over Poupart's ligament, there are not any certain means of ascertaining the precise seat of the stricture until the ligament itself is exposed by the operation. Yet it is so constantly within a very short distance of the femoral ring, that we may, for the purposes of the operation, assume the ring to be the part to which we may most advantageously direct the necessary incisions. It is, however, necessary to recollect that it not infrequently happens that the real seat of stricture is on the thigh, to the extent of half or three-quarters of an inch below the ring. In this case it is caused by bands of fascia, which immediately invest the sac at that part; they are probably derived from the transversalis fascia, and have been described as the fascia propria of the sac.

The femoral ring being the desideratum, it becomes the question how that aperture can be most readily reached. When the tumour rises as described, an incision upon it directly over the femoral ring manifestly involves a necessity of subsequently directing the incisions to its upper part, after which they must be directed downwards, between the tumour and tendon of the external oblique muscle, to the ring. In this manner a circuit would be made, in some instances of probably more than one half of the tumour, a very great part of which would in no way assist the surgeon in the attainment of his object; but, on the contrary, would delay his proceedings, prolong the pain, and increase the dangers of the operation. It is far preferable to avoid incisions over the tumour as much as possible. This may be accomplished to a very great extent by the plan of operating which I have usually adopted in such cases.

It will be recollected that there is almost always a groove or depression of the integuments, which defines the upper limits of the tumour upon the abdominal surface. Where no depression can be seen, the boundary of the tumour may be ascertained by the pressure of the finger in that situation.

A fold of integuments is to be pinched up at that part, and divided by transfixing it with a narrow knife, so that the incision, when the skin is replaced, shall fall perpendicularly to the body, with its centre opposite to the depression referred to. By a few strokes of the scalpel the tendinous expansion of the abdominal muscles is to be laid bare; after which a finger should be introduced as far as Poupart's ligament, between the tendonious expansion and the tumour, when the latter rises upon the former. The ligament being thus exposed, a hernia-director is guided under it by the finger into the femoral ring, the margin of which may be safely and easily divided in an upward direction with a common probed bistoury, and the taxis applied in the usual way. Should the margin of the ring have formed the stricture, the taxis for the most part succeeds very readily, and the operation is completed in a very short time. But should the stricture be caused by the bands of fascia propria referred to, the director will have passed over them as it entered the femoral ring, in which case any amount of division in an upward direction will be of no avail. When the taxis does not succeed readily, these bands of fascia may generally be suspected to be the cause of failure. The fact may be made sufficiently clear by introducing the finger upon the neck of the sac, under Poupart's ligament, while the body of the sac is pressed between the fingers and thumb of the other hand, when it will be discovered that no impulse is communicated to it by such pressure. By a little attention the bands may be detected crossing the neck of the sac from half to three-quarters of an inch below the ring, and may be divided by insinuating the nail of the fore-finger of the left hand under them from above, and by carrying the point of a probed bistoury along the nail, with its blunt edge towards the sac. The division is made by the surgeon drawing the bistoury away from the sac towards himself, a proceeding which, if properly performed, avoids all danger of wounding the sac or its contents. It is probable that to a want of knowledge of this frequent seat of stricture, so far below

the femoral ring, caused by these bands of fascia, failure of success in the performance of Petit's operation in this kind of hernia is often to be attributed. With this knowledge I believe failure will be infrequent, unless from causes which exist within the sac, arising from changes in its contents, a circumstance by no means common in cases of recent descent.

Of umbilical hernia a sufficient number of cases have not fallen under my notice to justify my speaking confidently upon the subject. From what I have seen of these cases, when the sac has been opened by other surgeons, or by myself, I am disposed to the opinion, that Petit's operation is not so well suited to umbilical as to inguinal or femoral hernia, except when the hernia is of small dimensions. It is a well-known fact that, in the larger and older forms of the disease, a very large portion of the tumour is usually composed of masses of omentum, often rendered thick by the deposition of fat. In this mass the intestine is liable to become enveloped and even strangulated. Should either of these circumstances occur, Petit's operation may be uncertain or dangerous, and consequently is not to be trusted. When, however, the hernia is of recent date, previously reducible and of small dimensions, it appears to me that Petit's operation is equally suitable to such cases as to those of which I have already spoken.

Similar objections to those which I have just stated, have been urged against Petit's operation in all cases. Without insisting that the same objections may be generally raised to the ordinary application of the taxis, it may be observed that, in inguinal and femoral hernia, entanglement and strangulation of the contents amongst themselves are far less likely to occur than in the larger forms of umbilical hernia; and that this difference depends upon their greater distance from the sources of mischief, and their consequent comparative immunity from the protrusion of large masses of omentum, the frequency and magnitude of which must be taken as the measure of the danger under consideration. It is not intended

to assert that the danger does not exist even in inguinal and femoral hernia; but it may be asserted with truth (which experience confirms) that it exists in these forms in a very slight degree, and certainly not to an extent that should influence our proceedings with respect to Petit's operation. In large herniæ, where there is a greater probability of the protrusion of large masses of omentum, the danger is somewhat greater. Surgeons, however, have already agreed that it is desirable to avoid opening the hernial sac in large herniæ, justly concluding that the danger, arising from the exposure of a large mass of hernial contents to atmospheric and other baneful influences, is far greater than that arising from any liability to entanglement; the force of which conclusion increases with the magnitude of the hernia. If, therefore, surgeons are agreed (and I believe almost all are so) that Petit's operation is properly applicable when the danger of entanglement is great, it appears, *à fortiori*, that entanglement has little weight, as an argument against the performance of the same operation, in cases of small herniæ, in which the danger can scarcely be said to exist.

Embarrassments may occasionally arise from the existence of adhesions between the hernial contents and the sac. These may be either recent or old. With respect to the first, it is not probable that they will be frequent if the operation be performed at an early period of strangulation, nor likely to form any serious obstacle to the return of the hernia, while in a soft state; for then they may be broken down in the ordinary manipulations of the taxis. When of greater consistency, they form so serious an obstacle to the taxis as to render the opening of the sac necessary for the reduction. Old adhesions imply a previous irreducible condition of the hernia,—a state which the history of the case will make known to the operator. Should these exist, it rarely happens that the adherent parts become the subject of serious strangulation, but some new protrusion which seems to receive the whole influence of the stricture. If this part be liberated by an operation, surgery has done all that is

required in the case. In liberating and reducing so small a part of the hernia as these new protrusions frequently are, some doubt may exist in the mind of the surgeon whether the relief has been sufficient and effectual; for that part, which was previously irreducible, still remains so. The signs of liberation, however, are usually sufficiently clear and decisive, that little or no uncertainty need be apprehended. Should any remain, the sac should be opened; but to a limited extent. While operating in such a case the surgeon will be satisfied if, under the pressure of the taxis, he feels a portion of tumour slip from beneath his finger through the abdominal aperture, followed by a relief to the tension of the remainder. The signs of success become more marked as the taxis proceeds, until generally no reasonable doubt remains that effectual relief has been afforded. The successful performance of Petit's operation in such cases has this important advantage, that adherent parts which necessarily must remain in the sac unreduced, have not been exposed to any injurious influence, and are placed in a condition for the performance of functions very little, if at all, different from their accustomed state previous to the new descent.

The occurrence of mortification in the hernial contents is supposed to demand imperatively the opening of the sac, for the purpose of applying a special treatment to meet those dangers which are thought likely to accrue in such cases. Forcible as the arguments are, which the occurrence of mortification furnish for opening the sac, they are not very cogent as militating against the general adoption of Petit's operation: for the negative information, which the occurrence of sixty-two cases in succession supplies, is important to the point under consideration, and shows, at least, that mortification is rare; and it is probable that it will become more so under the practice of an earlier operation. One case only of mortification occurred out of the above number: but in that case to so limited an extent, as not to require any special treatment; the hernial contents being returned into the abdomen in the ordinary manner, followed by recovery

of the patient without any local ill consequences from the proceeding.

When the mortification of the bowel is extensive or general, the practice of opening it freely, and leaving the part in the sac unreduced, is the most advisable course to be pursued. But when small portions are mortified, the practice of leaving it unopened, and of returning it into the abdomen, appears preferable. In this case there is a very great probability that the continuity of the canal will remain undisturbed, by reason of the lateral aperture, formed in it by the separation of the mortified part, usually becoming closed by adhesions of its margins to the abdominal parietes or adjoining viscera. The mortified part is thus rendered capable of being discharged into the intestine itself, without the occurrence of effusion into the peritoneal cavity. Such cases, therefore, do not render Petit's operation improper, because, if fully ascertained, they would not receive any treatment beyond the usual taxis. Nor does it appear that the liability to effusion into the general peritoneal cavity is in any degree increased by the sac remaining unopened. If effusion occur it will be equally disposed towards the sac, whether the sac be opened or not; while the evidence of effusion into the sac when unopened will be sufficiently marked to enable the surgeon to open it when the necessity arises, and before further ill consequences ensue. It must be evident that if the sac had been opened in any one of the above sixty-two cases from a dread of mortification, the proceeding, on that account, would have been wholly unnecessary; and, consequently, a positive danger would have been inflicted by the operation, which the circumstances of the case did not demand. Although the occurrence of extensive mortification is a contingency to be calculated on in the ordinary performance of Petit's operation,—yet, if the results of that operation shall inspire surgeons generally with a confidence of greater security than that which they derive from the ordinary operation, it is highly probable that they will appeal to it at an earlier period than they are now accus-

tomed to do, with the highly probable effect that those circumstances, which now are supposed to militate against it, will become much diminished in frequency. It is true that by adopting an early operation we do not avail ourselves of all the chances of a successful taxis by protracted efforts; and that occasionally operations may be performed, which protracted efforts might have rendered unnecessary. Admitting this with its fullest force, it weighs but little against the adoption of an early operation as a rule of practice. It seems far preferable that a few patients should be submitted, even unnecessarily, to an almost harmless proceeding, than that all should be submitted to the too often fatal consequences of procrastination; for the inconveniences of Petit's operation, when successfully completed, bear no proportion to the magnitude of the dangers removed by it. Should the attempt to perform this operation fail, the alternative remains of opening the sac in a manner that need not subject the hernial contents to exposure and irritation, except to a very limited extent. The circumstance, although a failure, argues the propriety of an early operation.

It will be recollected that the difficulties of the taxis, arising from the tumefaction of the hernial contents, increases with the duration of strangulation up to a certain point; and that, consequently, the taxis is most readily performed at an early period, before that tumefaction has taken place. It will be recollected also, that the attempt to perform Petit's operation creates facilities to the taxis, by the division and removal of parts which surround and support the immediately constricting cause. Should failure take place at an early period, under circumstances most favourable for success and with all the aids afforded by a limited operation, it seems wholly improbable that the taxis, without those aids, would have any chance of success, however long it may be protracted. A failure of the operation, when properly performed, may, indeed, be taken as a direct proof, that the taxis alone would not have succeeded; while a successful performance of it (even if unnecessary) will have entailed

upon the patient little more than an unimportant division of the integuments, without any unnecessary new danger legitimately attributable to the surgeon's proceeding. But infinitely more generally there will be a satisfaction, arising out of the supposition that relief to the patient has been afforded at an early period, by an operation which (if precipitation be avoided) there is very great reason for expecting would have become most urgently necessary at a later period, under circumstances of delay likely to produce a very great augmentation of danger.

# A CASE

OF

# VERY EXTENSIVE GELATINIFORM

# CANCER OF THE PERITONEUM,

## INVOLVING THE LYMPHATIC GLANDS OF THE ABDOMEN AND THE OVARIES, AND SIMULATING ASCITES.

By EDWARD BALLARD, M.D.,

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Received Feb. 19th—Read March 14th, 1848.

Jane Last, aged 55 years, residing in the neighbourhood of Burton Crescent, placed herself under my care at the St. Pancras Dispensary, on January 17th, 1848. The history of her illness taken at that time is as follows :—

She is a native of Boston, but has resided in London during the greater part of her life. She was married at 29 or 30 years of age, and her husband is still living. In two years time she aborted at the third month, and never again became pregnant. The catamenia appeared rather early, namely, between 11 and 12 years of age, and she used frequently to suffer from dysmenorrhœa. She has never undergone any privation, and has always been extremely temperate and regular in her habits. No particular hereditary tendency can be traced.

Previously to her miscarriage she had suffered from no abdominal symptoms, but three or four years before had undergone an attack of typhus. At the time of the miscarriage, however, there was such an amount of pain and tenderness

at the epigastrium as to induce the medical man who attended her to apply leeches and a blister. From that time forward she has been in the habit of suffering from flatulent distention of the abdomen after meals, especially if she partook of any kind of pastry, raw vegetables, or soup.

At 45 years of age, that is to say, ten years ago, the catamenial periods became irregular, the interval varying from two to six weeks, the discharge on each occasion being excessive, and lasting for one or two weeks, accompanied as usual by severe abdominal and lumbar pains. This menorrhagia continued up to the final appearance of the catamenia between the ages of 51 and 52 years. She never suffered in the intervals from any leucorrhœal discharge.

At the time of the menorrhagia (the exact period I have been unable to determine), she consulted a practitioner in her neighbourhood, who cupped her over the sacrum, and applied leeches to the cervix uteri, and informed her that there was a tumour connected with the liver, which could be readily felt beneath the margin of the ribs on the right side. Attention was drawn to this in consequence of the uneasiness and tenderness at the epigastrium having so much increased that she was unable to bear the ordinary pressure of her clothes; and she occasionally experienced the "sensation as of a knot," referable to that region, which was commonly relieved by a dose of aperient medicine, and the evacuation of mucous stools mixed with long membranous shreds.

On the cessation of the catamenia, her health became so much improved that both her friends and herself anticipated in a short time its complete restoration. This improvement was only interrupted, about two years ago, by what she was told was "inflammation of the veins" of both legs: no clear account of this attack could be obtained.

In June 1846, she accidentally slipped from some steps. A few days after she began to complain of a sense of bearing down, and soon discovered a prolapsus of the womb. On account of this a ring pessary was introduced, but as there was much trouble in keeping it in its place, and it gave her

great inconvenience, after a three months' trial its use was finally abandoned, and the uterus has not prolapsed since.

Just at this time she perceived that she was passing a smaller quantity of urine than was natural to her, and that her abdomen was beginning to enlarge. The enlargement was first noticed at the lower part, and was accompanied by such a sense of weight there that she was in the habit of supporting it with her hands while walking. She also noticed a tumour above the pubes, "about the size of a turkey's egg," which, with that beneath the margin of the ribs, subsequently disappeared as the abdominal enlargement increased.

At Michaelmas in the same year, while walking in the city, she inadvertently struck her abdomen against a post with considerable violence, and ever since that time the epigastric uneasiness and sense of a knot there have been much more troublesome; but there has been throughout no lancinating pain.

The abdomen continued to increase in size, and in October last she began to vomit her food. At the beginning of November she entered King's College Hospital. The bowels up to this had been regular, but now became constipated, a change which she ascribed to the administration of opiates for the relief of her pain. Vomiting soon became of nearly daily occurrence, accompanied by violent epigastric pain, the matter thrown up being greenish and sour, but never fæcal. Solid food or broth induced violent cramp-like pain at the epigastrium, and sense of distention, remaining till she was relieved by vomiting after her tea. While in the hospital she began to suffer from œdema of the ankles, which subsequently extended to the thighs and lower part of the abdomen. Three weeks before leaving it she had an attack of diarrhœa.

She left the hospital of her own accord on December 29th. Since then the vomiting has continued, but the bowels have been more regular. She has been complaining very much of chilliness, and is compelled to lie between the blankets for warmth. She has been losing flesh ever since the

prolapsus, and presents a considerable degree of emaciation, where it is not disguised by œdema. The countenance is expressive of great anxiety; the complexion is not more sallow than is natural to her, and the cheeks are marked by fine purple veining.

There has been almost complete orthopnœa for five months past. She states that a sense of dragging and of cramp-like pain at the epigastrium is produced when she lies on the left side, and to a less extent when on the right. The pulse is small and ninety-eight, while the respirations are thirty, in the minute. There is great tenderness at the epigastrium and below the margins of the ribs, especially on the right side, and the tenderness extends as high as the dulness of the liver. There is tenderness also above the pubes, and deep in the left iliac region. There is much thirst, and the tongue is clean and smooth down the centre.

On examining the abdomen, its enlargement was found to be general and rounded, the epigastrium very full, and the umbilicus remarkable as not being prominent but stretched and flattened out. There was no enlargement of the superficial veins, but the cuticle was exfoliating in large pieces. The abdominal wall was tense, except at the epigastrium, where it yielded readily to the hand. By sliding the hand over the surface, there could be felt in the abdominal wall, about its upper part, seven or eight small tumours, about the size of a nut, all unconnected with any solid organ beneath, except one, which was situated near the cartilages of the ribs on the right side of the epigastrium and not far from the ensiform cartilage: this one was felt to be continuous with a solid tumour, about the size of an egg, which passed upwards under the cartilages of the ribs, and apparently belonged to the liver.

On the most careful examination no other tumour could be felt, except one just above the pubes, and this with some difficulty. It rose about three inches above the pubes, extended equally on either side to the total width of about four inches and a half, was immovable, and lobulated.

Pressure over any part of the abdomen produced great increase of the dyspnœa. There was a little resonance on percussion at the epigastrium and along the margin of the ribs on the right side, but in every other situation the dulness was complete, and there was the most perfect fluctuation in every part. The dulness of the liver was perfect as high as the fifth rib. The abdomen measured forty inches and a half in circumference, two inches above the navel.

In front the pulmonary resonance on percussion was good, and the respiratory murmur natural, but accompanied by some sibilant and mucous rhonchi. The heart's dulness was of natural extent, but the apex was beating beneath the third rib. Posteriorly the dulness of the liver rose as high as the lower angle of the scapula, and the resonance on the left side extended only about two fingers' breadth lower. There were no physical signs of pleural or pulmonary disease.

On digital examination the vagina was found to be altered in direction, passing upwards and forwards behind the pubic symphysis, and was broad and capacious. The cervix uteri was not to be detected, but the os uteri terminated the vagina opposite the upper extremity of the pubic symphysis, and was of natural size. By means of Simpson's sound the cavity was noticed to pass forwards in the direction of the tumour, felt in the middle line above the pubes, and the organ was immovable. In addition to this, there could be felt through the posterior wall of the vagina an irregularly nodulated elastic tumour, engaging the upper part of the pelvic cavity; it did not give to the finger any impression which led me to believe that it contained fluid.

It will occupy too much space to enumerate the grounds on which my diagnosis was based, but the conclusions I arrived at were as follows:—1st. That there was ascites. 2ndly. That cancerous disease existed most probably about the inferior part of the liver and transverse fissure, and probably also about the larger divisions of the postal vein. 3rdly. That there were cancerous nodules in the abdominal wall. 4thly. That there was fibrous tumour of the uterus.

5thly. That there probably was encysted ovarian disease. The more important parts of this diagnosis were communicated to my colleagues, Dr. Stewart and Mr. Walton.

I ordered her no medicine, but directed that she should take nothing but a table-spoonful of strong beef-tea every ten minutes, and that an enema of warm water should be used every morning. As I anticipated, this had the effect of removing the vomiting, and very much lessening the pain, while the bowels were acted upon regularly.

As the poor woman expressed a desire to be tapped, and there was a prospect of temporary relief to the dyspnœa being afforded by the operation, I requested Dr. Stewart to visit her with me, and as he saw no reason for deferring it, it was performed on the 24th, by Mr. Walton. Both these gentlemen felt equally convinced with myself, that there was fluid in the peritoneum. The trocar was introduced just below the navel, in order to avoid any tumour which might extend higher from the pelvis than we had physical evidence of. Nothing, however, passed through it, but about a tea-spoonful of clear gelatinous matter, which at the time struck me as so similar to that of gelatiniform cancer, that I remarked it to Mr. Walton. Still the idea that the peritoneal sac could be full of this matter was at once exploded; and under the belief that possibly the trocar might have penetrated a cyst of some kind, we agreed to another puncture being made, a couple of inches higher, in the hope of finding fluid; but here, again, the result was similar. A little opaque white matter accompanied the jelly from the second puncture. The patient was accordingly put to bed, and in the evening, when I visited her, though plainly not fully recovered from the shock of the operation, no unfavourable symptoms had arisen.

On the 25th, I found her complaining more of epigastric pain; there was no tenderness about the punctures, but much thirst; she had not vomited, and the bowels had acted spontaneously; the pulse and respirations were as before the tapping. After passing a very restless night, however, during

which she suffered severely from epigastric pain, she died on the morning of the 26th.

The body was examined twenty-six hours after death.

*Head.*—The dura mater was universally adherent to the calvarium; the brain, slightly congested.

*Chest.*—The lungs were small, and did not reach, in front, below the level of the fourth rib. Here and there, near their apices, a little cheesy tubercle and some gritty matter were discovered. The left lung presented a little congestion posteriorly. The heart was healthy, but its apex was situated opposite the third intercostal space. There was more or less atheromatous deposit throughout the whole length of the aorta.

*Abdomen.*—On opening the abdomen, the peritoneal cavity was discovered filled with gelatinous matter, and in the course of the examination no less than six quarts were, with more or less difficulty, removed: the difficulty arose from its remarkable tenacity, which was greater in the deeper parts than near the surface. It emitted a very disagreeable, faint, sickly odour, resembling that commonly perceived in the contents of the stomach after death. It possessed a ruby tint superficially, but in the deeper portions, and pelvis, it was less clear, and was streaky, some portions being pearly, and others having the colour of crude rock salt. In the epigastric region, there was some reddish-brown opaque liquid, containing some shreds of lymph. On turning aside the abdominal wall, the peritoneal lining was seen to be infiltrated with colloid, in the form of nodules and little masses, intersected with little fibro-cellular bands forming loculi. This gelatinous matter was not separated by any membrane from that in the cavity. There were a few spots of ecchymosis, also, about the lower part of the wall. In its upper part, the nodules felt during life were found to consist of small, hard, flattened tumours, about a quarter of an inch thick, and measuring three-quarters of an inch in diameter, placed beneath the peritoneal lining. There were shreds of lymph attached to the wall and organs in the epigastrium and hypochondria.

When the loose jelly was sufficiently removed, the following appearances were presented:—

1st. The epigastric tumour was found to depend upon a colloid infiltration of the peritoneal investment of the left lobe of the liver. 2nd. The suspensory ligament was infiltrated with it. 3rd. The diaphragm was adherent to the right lobe of the liver, over a great part of its upper surface, and to the spleen; and where unattached, its peritoneal lining was infiltrated in the same manner as the abdominal wall, and contained also small tumours of the same growth. 4th. On the right side of the abdomen lay a large tumour, consisting of colloid, and nodulated on the surface with gelatinous matter. It was broad above, where it was separated by a moderately deep furrow from the liver, but narrow below, where it adhered to a tumour in the hypogastrium. Its entire right border was free, as was also the lower half of the left. From its left side, above, a prolongation extended outwards and backwards, to become continuous with some colloid matter on the surface of the spleen, and was connected by peritoneum with the great curvature of the stomach. The upper part of the tumour presented tuberous elevations on it, and consisted of the mesocolic glands, in a state of colloid degeneration. The remainder, with its prolongation, was formed by the omentum in a similar condition. 5th. In the hypogastric region, a solid tumour was situated, adherent on its anterior surface, and on the right side to the abdominal wall, and there was colloid matter in the adhesions. This tumour was largely lobulated, and was connected to the colloid omentum by means of one of its large globular elevations. Towards its left side and upper part, it was connected with a fibrous sac, presently to be noticed. The dimensions of the tumours were those observed during life. 6th. On the left side of the abdomen, extending upwards nearly to the margin of the ribs, and downwards to the iliac fossa, were situated the remains of a large sac, whose cavity extended, to the right, behind the great lateral tumour of the omentum, and communicated with the general cavity of the peritoneum in the

right flank. This sac, when perfect, could not have contained less than three pints of matter. Its contents were a jelly, less transparent and more opaline than what was lying free in the peritoneum, and very firm. Its colour was like that in the deeper parts of the cavity of the peritoneum. The sac itself, as it appeared anteriorly, consisted of a very dense fibrous tissue, and presented sacculi. It was more or less vascular in all parts, but the part attached to the hypogastric tumour was very much so, the vessels being abundant, running in a vertical direction, and giving a red colour to the surface. There were openings in the sac, by which it communicated with the peritoneal cavity, and the gelatinous contents communicated also with that of the peritoneum, the transition in firmness and colour from one to the other being gradual. One remarkable opening was situated on the anterior part of the sac; it was about three inches in diameter, and rather rounded in form. The sac was also broken down towards the left side, and again at the right side of the colloid omentum. It was connected with the uterine tumour, and with the left edge of the omental mass. 7th. A coil of small intestine was situated in front of that part of the omental mass which proceeded towards the left side, to be connected with the spleen:—the convolutions were adherent by lymph not very recently effused.

The liver was of the ordinary size; its capsule, opaque and thickened; its peritoneal coat, infiltrated with colloid, in most parts of the lower half of the organ. In the lower border of the left lobe, this had occurred to some extent, and constituted the tumour felt during life in the epigastrium. The parenchyma of the organ was healthy. The glands about the transverse fissure were enlarged, and converted into masses of colloid.

The spleen was enveloped in a capsule of colloid, with the exception of the upper and inner portions. The stomach was empty, flattened and contracted, especially towards its pyloric extremity. The mucous membrane was healthy. A small deposit of colloid was situated on the peritoneal surface

posteriorly. There were some portions of colloid connecting the tumour of the mesocolon with that on the surface of the liver, crossing the pyloric extremity of the stomach. The greater part of the small intestines was situated in a small space behind the portion of the tumour which represented the transverse mesocolon, and in front of the right kidney. They were here rather contracted in diameter, but presented no indication of peritoneal inflammation. The mucous membrane was natural. Tubercular elevations of colloid, varying in size from that of a hemp-seed to that of a half-walnut, were scattered over the peritoneal surface. The mesenteric glands were similarly infiltrated with colloid, but were not affected to the same extent as the mesocolic glands. There were nodular deposits of colloid also on the peritoneal surface of the cæcum and colon, and the appendices epiploicæ and the mesocolic glands were deeply implicated; the latter, very much enlarged, and converted entirely into colloid matter. The transverse colon was traced passing in a tortuous manner through the great lateral tumour, marking off the portion above as belonging to the mesocolic glands, and that below as belonging to the omentum. Its diameter was contracted, but the mucous membrane, so far as it could be examined, was healthy. Near the extremity of the cæcum, one colloid mass passed through the muscular coat, and its structure could be seen through the thin layer of mucous membrane which covered it internally. This was the only part of the whole canal where so deep a penetration of the disease had taken place. There were masses of colloid also attached by peritoneum to the sides of the rectum. The pancreas was completely free from disease.

The fundus of the uterus presented some rounded globular elevations before noticed, of the ordinary fibrous character. The ovaries could not be discovered; but in place of them, at the sides of the uterus, and connected by the lateral ligaments to the wall of the pelvis, were fibrous sacs, presenting, externally, a more or less lobulated appearance. This external lobulation corresponded to an internal division into sac-

culi or cells, of rounded form, and each distinct in its cavity from the adjoining. The external ones were large, and embraced several of the smaller. The large sac or cyst, seen on first opening the abdomen, appeared to belong to the ovary of the left side. All these cysts contained a gelatinous, firm matter, which was adherent to their wall. No part of the cysts on either side extended into the pelvis far beyond its brim; but on both sides they pressed upon the iliac vessels and nerves lying on the psoas muscle, especially on the right side. On the right side a small portion of the cyst passed through the upper part of the great sacro-sciatic foramen. The bladder was small and compressed between the uterus and pubic symphysis, but otherwise healthy. The kidneys were healthy, but pale.

A microscopic examination of some of the locular masses, the gelatinous matter of the abdomen and that of the ovarian cysts, was made by Dr. Garrod and myself, and also by Mr. Marshall. The characteristic cells of cancer, simple, compound and caudate, were discovered in all; and, on adding acetic acid, they were found to be held together by a very delicate membrane, which tincture of iodine demonstrated to be very finely granular in its texture.

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*Remarks.*—Although I have searched diligently through the principal periodicals and systematic works, and have moreover looked through several museums, I have failed to meet with a single case presenting the extraordinary characters of that which has just been read. The extent of the disease is one of its most remarkable features, the microscope having proved the cancerous nature of all the gelatinous product found within the abdomen.

It is not unusual for gelatiniform cancer to attack the *omentum*; and sometimes it has, as in this instance, acquired a considerable bulk; but it has mostly occurred

secondarily to cancer of the stomach; while it is remarkable here as lying so completely upon the right side of the abdomen.

The occurrence of colloid of the *liver* is not admitted by Dr. Walshe, Dr. Budd, or M. Cruveilhier, and I only know of a single specimen of it, which was presented by Mr. Kiernan to the Museum of University College. It there forms large masses in the parenchyma of the organ. In the case now before the Society, the peritoneal investment alone is implicated.

I have been able to discover no example of colloid affecting any part of the *spleen*.

The *lymphatic glands* have suffered much more from the disease than those parts of the alimentary canal with which they are connected—throughout which there is no part where the entire wall has been infiltrated; the colloid being thinly scattered over it, and only on the peritoneal surface.

The *peritoneum and its lymphatic glands* constitute the chief seat of the affection. I am unacquainted with any case in which the lining of the *abdominal wall* was so extensively infiltrated as in this. A few years ago, a case of extensive gelatiniform cancer, affecting most of the organs of the body, was, I believe, communicated to the Society by Dr. M. Hall; but I have been unable to discover how far it agreed with mine, inasmuch as only an outline of it is to be met with in the periodicals of that date. I may refer to the *ecchymoses*, in the midst of the colloid infiltrating the lower part of the wall, as something unusual in this variety of cancer. The occupation of almost the entire *peritoneal sac* by colloid matter is, so far as I have been able to discover, without a parallel in the records of medical experience.

Dr. Walshe remarks that he has never himself "observed colloid in the *ovaries*, nor met with any faithful description proving that other observers have been more successful."

Cruveilhier, on the other hand, admits its occurrence; and although, as all must allow, on very insufficient grounds, yet I have reason to believe that his opponents are called

upon to modify, in some degree, their complete condemnation of his views.

Dr. Walshe remarks, that "one of the distinguishing attributes of the colloid species of cancer is its apparent insusceptibility of assuming such variation of internal arrangement as to call, in this point of view, for the establishment of varieties."

In the present instance, however, three forms are clearly discernible:—one, is the ordinary *locular form*; another, is the *encysted form*; and the third, is a *free or unincluded form*. Regarding the first, nothing further is required to be said; but the other two call for a few observations. The term "encysted gelatiniform cancer" originated with M. Cruveilhier; who, taking into consideration the gelatinous appearance of the matter sometimes contained within ovarian cysts, and its enclosure within cavities having fibrous or fibro-cellular walls, instances of which abound in the cases recorded by medical writers, rather hastily sums up his conclusions in these words:—"In short, it is with gelatiniform cancers that we must class the ovarian cyst, which only differs from gelatiniform cancer of the stomach and other tissues by the size of its meshes."

Few pathologists have been found to coincide in this opinion; but, nevertheless, it appears probable that the other extreme, which denies a malignant character to any ovarian cystoid disease, is likely to be no less erroneous. At all events, in the case before us, microscopic examination has demonstrated in the gelatinous matter of the cysts the same minute structure as was found in that from the loculi, so that if we admit the malignancy of the latter, we cannot deny it in the former. But this case does not stand alone, since I would direct attention to one brought before the Medical Society of London, a few years ago, by Dr. Frederick Bird. In that instance an ovary had become converted into a large cyst, containing a firm gelatinous matter, in which Dr. Golding Bird and others, by microscopical examination, discovered cells agreeing in appearance with those found in

other forms of malignant disease. To say the least of it, these two cases deserve to be taken into consideration, in connection with the frequent conjunction of ovarian cystoid affections with cancerous disease of the pelvic or abdominal organs, before we decide finally against the completely malignant character of the former. I am aware that another explanation of the existence of cancer-cells in the gelatinous matter of the cysts in the present case may be afforded, namely, that the contents of the cyst might at first have been non-malignant, and that they might have acquired the cancerous character subsequently to the bursting of the cyst, by contamination from the neighbouring diseased tissues. Nor would the view of its original malignancy be in any way strengthened by the discovery of cancer-cells in the smaller and more recent cysts, although their absence in the latter, had it occurred, would have weighed strongly against it. Still the admission of this explanation does not destroy the fact of malignancy, which is all I argue for; much less does it affect in any way the inference to be drawn from Dr. F. Bird's case.

I have already stated that I have failed in my search after another example of colloid matter lying free within the peritoneal sac. How it got there is a question of interest. Three modes may be imagined—1st. By escape from the ovarian cyst on the occasion of its rupture. 2nd. By growth from the diseased part of the abdominal wall. 3rd. By the occurrence of fibrinous dropsy and its subsequent conversion into colloid matter. An objection fatal to the first of these views is, that at the time the rupture of the cyst is believed to have occurred, the abdomen was but little enlarged; and other evidence is in favour of its accumulation at a subsequent period. Besides, the fibrous cyst was inelastic, and at no time could have contained the vast quantity of matter found in the peritoneal sac. In deciding between the two remaining modes, the question resolves itself into this: viz., whether the plasma from which the cancer arose was effused merely from the diseased surface, or from the entire peritoneal lining,

healthy and diseased. Vogel admits "that the fluid of fibrinous dropsy is capable of organization," and that "it is indifferent whether the fibrin be in a fluid or coagulated state;" that from it "the most different forms of tissue, either normal or pathological, may be evolved:" and he enumerates cancer among the latter. Dr. Walshe, too, says, "that the blastema of cancer, there is every reason to suppose, is, like the ordinary exudation-matter, essentially composed of liquor sanguinis, but of liquor sanguinis modified in its vital properties;" and moreover agrees with Dr. Carswell, that in rare cases the free surface of serous membranes may secrete cancerous matter. It must be borne in mind, moreover, that there was present extensive disease about the large divisions of the portal vein and in the omenta, which would dispose to effusion into the peritoneal cavity.

Still I do not feel inclined to regard this as its origin, for the following reason; namely, that the parts furthest from the diseased portions of the abdominal wall were much firmer in consistence than those near to them, and were deficient in the faint and sickly odour so strongly marked in the latter. The pelvis, too, contained a matter nearly as firm as that in the largest cyst, and the surface of this portion was in no degree softer than the inner part of it.

One word more with respect to two of the signs observed during life. The very perfect character of the fluctuation was such as to lead the minds of those who saw the patient, to the opinion that the matter in the peritoneal sac was sufficiently fluid to pass through an ordinary trocar. I do not know in what way the fluctuation of gelatinous matter can be distinguished from that of ascitic fluid. Cruveilhier relates a case where an ovarian cyst containing gelatinous matter was tapped ineffectually, and acknowledges his inability to avoid a similar accident in future. In Dr. F. Bird's case, fourteen medical men were convinced, from the perfection of the fluctuation, that the cyst was distended with fluid. I was well aware too that even a solid organ will impart sometimes a sense of fluctuation to the hand, recollecting a

case a few years ago under the care of Dr. Williams, in University College Hospital, where it was very evident over a surface corresponding to an exceedingly enlarged spleen. Perhaps in any future case, should a similar one at any time arrive, the diagnosis might be assisted by the condition of the umbilicus;—the opening out, stretching and flattening of its fold, without prominence, being unusual, where ascitic fluid is of the ordinary character, and the abdominal wall free from disease.

# CASES

OF

# UNUNITED FRACTURE,

## SUCCESSFULLY TREATED.

By WILLIAM BOUSFIELD PAGE,

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Received Feb. 21st—Read March 14th, 1848.

Case I.—*Ununited fracture of radius and ulna. Removal of the fractured extremities of both bones at the end of thirty-four weeks. Recovery.*

Alexander S., aged 19, formerly an itinerant potter, but of late a railway labourer, was admitted into the Cumberland Infirmary, November 12th, 1845, with an ununited fracture of the left fore-arm.

He states that about seventeen weeks before his admission, while engaged on the railway, he was knocked down by a waggon weighing about five tons, which passed over a great part of the left side of his body, and caused the following injuries:—Fracture of the left clavicle, near its acromial extremity; fracture of some of the lower ribs of the same side, accompanied by hæmoptysis, which continued for several days; and fracture of both bones of the left fore-arm, at about the junction of the middle with the lower third; together with three wounds near to the seat of fracture, some or all of which probably communicated with it. There was also a wound over the elbow-joint, and he thinks he was informed that another fracture existed lower down in the same fore-arm; but of this there is now no evidence.

For six weeks he was confined to bed, during which time the arm was placed on a splint, and the dressings were changed every, or every other, day: no attempt, he says, was made to extend the limb, and but little attention seemed to be paid to keeping the fractured bones at rest.

When admitted, he appeared in not very robust health, although he considered himself nearly as strong as usual. The fracture of the clavicle, the situation of which was very evident from the deformity that remained, was firmly united; and if fracture of the ribs ever had existed, they also had united firmly and without displacement. The left fore-arm, which was much attenuated, he carried in a sling; it was about an inch and a half shorter than the right, and perfectly powerless from the great overlapping and free motion which existed at the fractured part: he was quite unable to raise the distal extremity, which dropped down in any direction as a dead weight. On examination it was found that the upper portion of the ulna was internal to, and overlapping, the lower to the extent of about an inch, and the lower end of the upper portion was drawn somewhat forward, so that a space existed between it and the lower part of the shaft of the bone. The overlapping of the radius was fully as great as that of the ulna, the upper extremity here being posterior to the lower; but there was little if any lateral displacement, and the lower portion was in close contact with the radial artery. Considerable hardness was felt in the structures around the broken ends of the bones, as if an attempt had been made by nature to affect union, such effort having been frustrated by the long interval between them, owing to their great overlapping; it was therefore determined, if possible, to extend the limb, but the means employed proved altogether ineffectual. Although there appeared to be scarcely a possibility of any benefit resulting from it, it was resolved that the part should be kept firmly bound up for a lengthened period, that he might have the full benefit of nature's attempt at cure. During the first few days, he complained of occasional pains about the seat of fracture, which gradually subsided: at the end of a month

the splints were removed, no change appeared to have taken place, and they were re-applied. His diet was liberal, including a pint of porter daily. Another month was allowed to elapse, when the limb was again examined, but it was found in the same state as at first. It was now once more bandaged as before, the seat of fracture being left bare in order that strong tincture of iodine, and other stimulants, might be applied. No benefit resulted, and the case having been left to the remedial powers of nature under the most favourable circumstances for nearly four months, both patient and surgeon were fully convinced that a further trial of any such means as those hitherto employed were useless, and the patient was extremely desirous that some other should be adopted.

The introduction of a seton being as little likely to be productive of advantage, as it would certainly have been attended with danger from the difficulty of avoiding the principal vessels and nerves, some of which were evidently much displaced, one means alone appeared to offer any probability of a favourable result—viz., the placing of the extremities of the bones in such a position as to render ossific union possible; and resection of the bones was the only method by which this reposition could be effected.

That the want of union in this case resulted from causes affecting the limb itself, and not from any constitutional peculiarity, was evident from the perfect ossification of the clavicle and ribs, and thus one part of the great difficulty which often exists in such cases, ignorance of the cause of the evil, was removed. Although the difficulties and dangers consequent upon the operation were fully considered, as was also the unsatisfactory result usually attendant upon it, the removal of the fractured ends of the bones was determined on, as preferable to the condemnation of the limb to amputation, or to abandoning the case as incurable. I believed also that the man would certainly not be in a worse position than at present, and that possibly even should union not take place, he might ultimately be in a better condition; for if the ends

of the bones could be placed in apposition, and some external support afforded to the arm, the muscular force on either side of the limb being so nearly balanced, it might be made in some degree useful.

March 9th, 1846.—The arm being laid on its flexor surface, an incision upwards of four inches in length was made directly down to the bone, immediately over the fracture, on the inner and back part of the ulnar side of the fore-arm. The muscles and the structures attached to this part of the bone having been carefully dissected from it, it was found that a very oblique fracture of the ulna existed, extending from above, downwards, backwards and inwards; the upper portion being internal and posterior to the lower, and at its extremity separated from it by a considerable interval. A slightly curved elevator was now introduced beneath the upper and more superficial portion of the bone, both for the sake of raising it and thus bringing it more readily into view, and also to protect the soft parts from injury. By means of a small Hey's saw, the division of the bone was effected, and a piece about three-quarters of an inch in length removed. The lower end of the bone was now seen; and the soft parts having been as much as possible detached from it, the elevator was with some difficulty introduced beneath, and an attempt at separation made with Hey's saw; but, owing to the depth at which it was situated, the entire removal of a portion in this way was found impracticable; the division was therefore completed with the cutting forceps, carefully and gradually worked through the bone, and about three-quarters of an inch was removed,—in all, upwards of an inch of the shaft of the bone. A second incision of equal length with the first was next made along the middle of the radius on the back of the arm, and the soft parts were separated from the bone. The fracture was here found to extend obliquely from above downwards, and the upper portion greatly overlapped the lower. In order that the operation on the lower end might be as limited as possible, since, from its great depth and the contiguity of the radial artery, this was

looked upon as extremely hazardous, a piece of bone fully an inch in length was removed from the upper part, in the same way as that from the ulna. And now much difficulty was experienced in raising the lower end of the bone sufficiently to allow it to be brought within reach of the forceps, and to admit of its being subsequently placed in apposition with the upper extremity. This was, however, at length accomplished, and the end of the bone was removed with the cutting forceps, without hæmorrhage, although the radial artery was felt in close contact with the finger at the bottom of the wound. The excision of this portion of the bone might have been much more readily completed by an incision over it on the flexor surface of the arm, where it was very superficial; but it was of importance to retain that part entire, to allow of the subsequent application of a splint. The two ends of the radius were now brought into linear apposition, and there held while an attempt was made to approximate the divided extremities of the ulna, which was effected with much difficulty; and it was found necessary to remove a further small portion of that bone, it being rather longer than the radius.

Both bones being now in proper position, the edges of the wound were brought together with strips of lint encircling the limb, and the arm and fore-arm were immovably fixed to an angular splint with strips of adhesive plaister, the fore-arm being maintained in a position between pronation and supination. Not more than an ounce of blood was lost during the operation, which occupied fully three-quarters of an hour, and was borne without a murmur.

The constitutional disturbance consequent upon the operation was not at any time such as to give rise to anxiety on the patient's behalf. The wounds were every day dressed with wet lint, and occasionally a fresh splint was applied, great care being taken at such times to prevent displacement; the arm lay constantly on a pillow, and the man was kept in bed in a recumbent posture. The wounds healed rapidly and without interruption, with the exception of the

formation of an abscess over the radial side of the arm in the beginning of April.

On the 13th of April, the wounds being healed, the whole fore-arm and arm were encased in a dextrine bandage (mucilage of gum arabic and whiting), outside which a light wooden splint was applied, and over all a second dextrine bandage; thus forming a perfectly immovable enclosure.

As he complained of some pain over the inner condyle of the humerus, the bandages were removed on the 1st of May; and that part being protected from pressure, the same applications were repeated. A very careful examination was made; the ends of the bones were in perfect position, and union appeared to be becoming firm, although the part still admitted of motion.

May 22nd.—The bandage was this day removed; union was quite firm between both bones, and he was able to lift the arm. The wrist-joint was nearly motionless, from the long-continued rest to which it had been subjected. He was unable to use his fingers, and the power of pronation and supination appeared to be lost. To prevent the possibility of injury, a single dextrine bandage was applied.

June 2nd.—He complained of pain about the seat of fracture; the bandage was removed, and the fore-arm was perfectly firm. Two dextrine splints were placed along the limb, one on the anterior, the other on the posterior, surface, and were retained in position by a common roller.

On the 5th of June he left the hospital.

June 15th.—When he came on this day it was evident that the bandage had been removed since he had been discharged; and, on inquiry, he admitted that, feeling the arm quite strong, he had taken off the splints the day before, and had lifted a chair with that hand. His fore-arm was nearly an inch and a-half shorter than its fellow; it was certainly less emaciated than it had hitherto been.

November 23rd.—He came to show himself at the hospital. He has for several months followed his former avocation, that of a carter on the Lancaster and Carlisle Rail-

way. He says that the injured arm is quite as strong as the other, and nearly of as much use as ever; and the only inconvenience he finds, and this he did not mention until very closely questioned, is that he feels a "tightness" at the fractured part, when he forcibly flexes or extends some of the fingers. The muscles of the whole arm have become much more fully developed, especially those above the seat of injury; the situation of which is rendered evident from this circumstance.

Case II.—*Ununited fracture of tibia and fibula. Introduction of a seton at the end of eight months. Recovery.*

Robert C., aged 16, was admitted into the Cumberland Infirmary, December 2nd, 1846, with ununited fracture of the right tibia and fibula. Upwards of six months before, he was run over by a waggon, on the Newcastle and Berwick Railway, by which both thighs were broken near the trochanters, and the right leg at about its middle: there was also an extensive wound on the outer side of the leg, communicating with the fibula, a considerable portion of which bone is now wanting. Splints were applied to the thighs for nine weeks, and others to the leg for about a month: the thighs have both united firmly, and with little deformity; in the leg, there is free motion at the seat of fracture, by which the limb is rendered perfectly useless. The fracture here appears to have been rather oblique, the broken ends of the bone are in apposition, and there is no evidence of any foreign substance being interposed between them; but there is displacement outwards of both portions of the bone, which form an angle of three or four degrees with each other. He states that but little care has been taken to keep the limb at perfect rest since the removal of the splints, and that even while they were applied it was frequently moved in dressing the wound.

In this case it was evident that want of union resulted from that most common cause of all, the not keeping the limb at rest during the continuance of that action on which

the deposition of ossific matter depends. It was, therefore, obvious, that the only means from which any favourable result could ensue, was the re-exciting a certain amount of inflammation in and around the fractured extremities of the bones. With this view I determined to employ, for a considerable period, firm and continued pressure, so applied as to ensure the co-aptation of the fractured extremities, together with perfect rest.

For two months the limb was as firmly encased in dextrine bandages as the patient could bear; but at the end of that time motion was as free, and union as imperfect, as on his admission; and as it was considered that the means employed might have been insufficient to induce such an amount of vascular action as was necessary for the production of callus, it was resolved that a seton should be inserted,—not between the ends of the bone, for this would have been highly dangerous, if not impracticable, but—on the surface of, and immediately along, the seat of fracture. Accordingly, on the 1st of February, I introduced two setons, each of four silken threads, the one over the outer, the other over the inner, surface of the fractured bone. Considerable inflammation was excited by this step, insomuch that it was found necessary to remove the threads on the 11th. The leg was again kept at perfect rest, for ten weeks; and, at the end of that time, on the 16th of April, was carefully examined, and I had the gratification of finding that the tibia was firmly united. A light dextrine bandage was again applied, and he was allowed to get up, and walk about carefully. The limb gradually became stronger and more useful, and he left the hospital on the 16th of June 1847: he returned from time to time, to show the strength of his leg, until the end of August, when he left this part of the country to resume his former occupation as a railway labourer in Northumberland.

Case III.—*Fracture of the tibia and fibula, ununited at the end of nine months. Perfect quietude of the limb for three months. Recovery.*

Edward S., aged 25, a muscular, well-formed man, while engaged in assisting a vessel into Maryport harbour on the night of December 16th, 1846, received a blow from a rope, which fractured the right leg at the junction of the middle and lower thirds. He states, that there was considerable displacement and hæmorrhage, but no protrusion of the bone, and that he was attended by a medical practitioner, who reduced the fracture and placed the limb in splints. Two days after he was seen by a bone-setter, who "worked over it two hours, and left it much worse than he found it." Three days after this the bone had penetrated the skin, and gradually protruded until two inches of it were visible, in which state it continued about eight weeks, when a wedged-shaped piece of the tibia, one inch and three-quarters long in front, and about three-eighths of an inch behind, was removed with a saw. During the next seven months the man was kept in bed, and the wound was frequently dressed,—the healing of the wound, rather than the quietude of the limb, appearing throughout to be the great end of the treatment. From time to time a considerable number of pieces of bone were removed, both from the wound over the tibia, and also from another on the fibular side of the leg.

September 15th, 1847.—The man was admitted into the hospital this day, his leg being at the time very neatly bound up in leathern splints. The displacement at the seat of fracture was by no means great, there was much thickening of the superjacent parts, and two large wounds existed, the one on the inner, the other on the outer, side of the limb; and motion was so free, that the leg could be shaken almost as readily as a flail.

The general aspect of the man at once conveyed the impression, that the want of union was not dependent upon any constitutional defect, and inquiry failed to discover the presence of any specific disease which might account for it. The

cartilaginous hardness of the textures around the seat of injury, while it prevented my obtaining that information which a manual examination of the part might have given, afforded presumptive evidence of an attempt at reparation having been made. The severity of the injury, together with the frequent manipulation to which the limb had been subjected during that period when rest was necessary, determined me, before attempting any other means, to keep the leg in a perfect state of quietude for several months; and this failing, to have recourse to the method proposed by Dieffenbach, of introducing some foreign body into the extremities of the fractured bone. The limb was therefore carefully fixed in a suspensory splint, the wounds being left open: at the end of a month these were quite healed, when the leg was enveloped in a dextrine bandage, and again placed upon the splint. Two months more were then allowed to elapse, when the bandage was removed, and the limb proved to be as firm as the other. He was ordered to get up, and to bring it gradually into use. On the 19th of January 1848 he was discharged, suffering only from the inconvenience necessarily attendant upon one leg being an inch and a half shorter than the other, and from some stiffness and swelling about the ankle: he was able to walk about the passages of the hospital with a single stick, and hoped again to go to sea at no very distant period.

This case affords, as I conceive, an interesting example of the advantage of abstaining from all active interference, until the curative powers of nature have been fully and fairly tried.

Case IV.—*Fracture of humerus. Union not commenced at the end of seven weeks, from want of sufficient nutriment. Recovery.*

Margaret B., aged 32, a poor, emaciated woman, the wife of a weaver, and mother of many children, fell forcibly against the edge of a loom, by which her right humerus was fractured about its middle. The arm was bound up in the usual way, and she attended, from time to time, at the hospital, of which

she could not be persuaded to become an inmate, as she had several young children at home. At the end of seven weeks there was no attempt at union,—a state plainly dependent upon the imperfect nutrition of the woman. She was now induced to leave her home, to stay for a time with her father, a farmer, in easy circumstances, the arm being bound up as before: at the end of a month she again appeared, looking healthy and well-fed; the limb was examined, and union was found to be perfect.

Case V.—*Fracture of tibia and fibula. Union not commenced at the end of six weeks. Administration of mercury. Recovery.*

James E., a footman, admitted October 30th, 1846, with an oblique fracture of both bones of the leg, received about an hour previously, his leg having become entangled in the wheel of a carriage; the displacement was by no means considerable. The broken limb was placed on the suspended splint I usually employ, and appeared in every way likely to proceed most favourably. Such, however, was not the case, for, at the end of six weeks, union had not commenced, and during the whole of that time he suffered much from severe nocturnal pains in the limb, and also from its extreme tenderness. On being questioned, he admitted that some months before he had had a chancre, of which he had been cured while under a mercurial treatment. He had now a sore-throat and eruption characteristic of constitutional syphilis, and also another chancre contracted shortly before his admission. A presumable cause of non-union was thus rendered evident; and as no reparative process could be looked for while the syphilitic poison was in active operation, it was considered that no means could be effective but such as would destroy the venereal virus. Mercury was, therefore, administered until the system was brought fully under its influence; the nocturnal pains and tenderness gradually ceased, the chancre healed, ossific matter was deposited around the fractured extremities of the bones; and, in the beginning

of February, union was sufficiently firm to admit of his leaving the hospital, the limb being bound up in dextrine splints.

In no class of affections which the surgeon is called upon to treat, is a correct appreciation of the cause of the malady more important; in none, perhaps, is that cause oftentimes more difficult of detection; and in none, are precise rules of treatment less generally applicable than where the fractural extremities of bones have not become firmly united by ossific matter. The foregoing cases furnish instances of the two great divisions under which all may be arranged; the one, in which non-union is dependent upon causes purely local; the other, in which there is no local impediment to union, but only a participation in causes affecting the system at large. In the last case the reparative process was evidently interfered with by the presence of the syphilitic poison; it was dependent upon a general cause, and, therefore, no local appliances could have produced any beneficial result. The local treatment remained unchanged, and union was not effected until the lurking poison was destroyed. In the fourth case also no change was made in the treatment of the fracture, which evinced no tendency to unite until the vital powers of the patient, so evidently deficient, had been raised to a more healthy standard. In the first three cases there was abundant evidence that the want of consolidation resulted from causes purely local; and that, therefore, local treatment alone was applicable to them.

The resection of fractured bones has so often been attended with a want of success, and has, in so many instances, placed the patient in a worse condition than before, that its all but universal rejection as one of the legitimate operations of surgery has been the consequence: but that there are cases in which this proceeding is alone applicable, the foregoing instance I conceive bears witness. When the overlapping of the bones is such as to render ossification impossible, or when the intervention of some foreign body has made it

equally so, no means can be availing without the exposure of the part and the removal of the mechanical impediment. But, however successful its adoption may be in particular instances, the importance of the operation itself, and the danger consequent upon the conversion of a simple into a severe compound fracture, must ever render it inapplicable except in a very limited number of cases; and in those only where the cause has been clearly ascertained.

ON THE

# IRRITABILITY OF THE MUSCULAR FIBRE

IN

# PARALYTIC LIMBS.

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&c. &c. &c.

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The Society did me the honour to publish a paper on the subject of the present communication in the Twenty-second volume of its Transactions.

In the last volume, or the Twelfth of the New Series, a paper on the same question is published, from the pen of Dr. Todd.

The conclusions to which Dr. Todd has arrived are at variance with my own. On first discovering this, I hastened to ascertain what could be the cause of the discrepancy between us, confident as I felt that my experiments and observations had been conducted with extreme care. I soon perceived that Dr. Todd had not employed the same kind of apparatus; and a few comparative trials established the fact, that in the difference of apparatus consisted the difference between our results.

## I.—*The Instrument employed.*

My object was to select such an apparatus as, being of the very *mildest* operation, should really be a *test* of the irritability of the muscular fibre of those muscles subjected to its

influence, and present the least complicated results. It was essential to avoid violence—to avoid all effects of timidity, surprise, sudden sensation, &c., evinced in starting, wincing, &c. I chose the well-known Cruikshank's battery or trough, the commonest, the simplest, the mildest, the most easily adjusted, of all. By means of this instrument I could apply a gentle galvanic influence, proceeding from ten, twenty, thirty or more plates, consisting of a simple current of low intensity; I could, in a word, apply the precise power required; viz. the lowest which would produce an obvious effect.

Dr. Todd has used the electro-dynamic or the magneto-electric apparatus. Now these are machines of great intensity; and instead of affording a simple current, inflict currents rapidly interrupted, repeated and even alternated; events, each of which presents its own peculiar effects on the muscle or on the nervous and muscular fibre.

But waiving the mere *à priori* objections, that the same instrument was not employed by Dr. Todd as by myself, it was impossible to conclude, without experiment, that the effects of instruments so different would be the same. I may now add, as the result of experiment, that, so far from being identical, the results afforded by the two instruments are *diametrically opposite*. We have, in this simple fact, the entire explanation of the discrepancies between Dr. Todd's statements and my own.

In effect, as my friend Mr. Henry Smith, to whom I am indebted for his most able assistance in all these experiments, early and acutely observed, the galvanic trough is, from its simplicity of operation and its low intensity, really a *test of the irritability* of the muscular *fibre*; whilst the electro-dynamic apparatus, from its extreme intensity and mode of action, displays the *power* of the muscular *mass*.

It may also be surmised, that whilst the simple current of low intensity acts principally on the superficial fibres, the rapidly-repeated galvanic agency, in its intense form, may penetrate to the deeper-seated *nerve*, and so display a degree of energy not observed in the other case.

And I beg here to lay before the Society an interesting fact, illustrating the effect, even upon nerves of sensation and volition, of disuse:—A frog had lost its inferior extremity, probably by some voracious fish; the divided thigh presented a stump perfectly healed. On examining and comparing the two lumbar nerves, I observed that that nerve which proceeded to the amputated limb had become atrophied. Doubtless this occurs in cases of disuse from paralysis; and, consequently, that nerve may lose more or less of its excitor power.

That Mr. Smith's view of this question is the correct one, is proved by an experiment which I have repeatedly made.

If the hands of a healthy person be subjected to the action of the electro-dynamic apparatus, they are energetically *closed*: the flexors muscles being more massive and powerful than the extensors, the former are more forcibly contracted than the latter; it is their *power* not their *irritability* which is tested.

But it is to an actual case in point that we must appeal; and I beg here to introduce an experiment, made to determine the question before us, viz. that of the results obtained by the two kinds of apparatus to which I have adverted. I give it in the words of Mr. Smith. It was made on the 10th of November 1847.

"In a case of hemiplegia of three years and a quarter's duration, in a man aged 28, the arm being slightly wasted and the hand contracted, the leg only a little enfeebled, we first applied the current from the common Cruikshank's battery, the hands being placed in salt water in one basin, the feet in another: on using a small number of plates, the muscles of the paralysed arm were found to be slightly affected by a current which did not influence those of the unaffected arm; on augmenting the number of plates, both arms were moved, but the paralytic arm more than the other.

"We now substituted Hearder's electro-dynamic apparatus for the Cruikshank's battery: both arms were moved, but the

unaffected more than the paralytic arm, the muscles being more powerfully contracted, as observed both by the sight and touch; a difference which became still more obvious as the power of the apparatus was augmented."

Having thus pointed out the source of the discrepancy between the results obtained by Dr. Todd and myself, I need not proceed any further. Still there are so many and such important questions involved in this inquiry, that I am anxious to be allowed to adduce fresh evidence of the statements made in my former paper. Most of all, I would call the attention of the Society to the great physiological principles involved in this inquiry—viz. that, whilst volition is an exhauster of the irritability of the muscular fibre, this irritability is essentially dependent on the influence of the spinal marrow; and to the important application of galvanism as a test of that irritability, and as a diagnostic between the cases of paralysis, in which, first, the influence of the cerebrum, or, secondly, the influence of the spinal marrow, is severally removed; for both these doctrines remain in their full force.

## II.—*The Terms employed.*

Before I proceed, I must also take this opportunity of defining the medical terms employed by me in this discussion.

In the first place, by *cerebral* paralysis, I mean any disease which *severs* the influence of the cerebrum, and consequently the acts of volition, from the paralysed limbs.

In the second place, by the expression *spinal* paralysis, I mean any disease which *severs* the influence of the spinal marrow from those limbs.

In my former memoir, I speak expressly of "the cases of paralysis arising from the severed influence of the spinal marrow, as distinguished from those arising from the severed influence of the cerebrum merely."

Cerebral paralysis usually depends on disease of the cerebrum, but spinal paralysis may depend on disease situated in any locality, even in the cerebrum, *so as to sever*

the influence of the spinal marrow from the paralysed muscles.

By the term paralysis, too, I mean *pure* paralysis, and I carefully distinguish such paralysis from cases in which *spasm*, "excited immediately from some disease affecting the spinal marrow" (or system) "itself," is superadded; cases which I have recently distinguished by the term *spasmo-paralysis*.

It is especially necessary to distinguish between such cases as, from involving "some disease affecting the spinal marrow itself," are attended by *early* spasmodic affection, and those cases of pure cerebral paralysis, in which spasm supervenes at a remote period, from the physiological action of the spinal marrow on muscles from which the influence of volition being withdrawn, the irritability of their fibre is augmented and their permanent contraction induced, presenting the only case, probably, in which such contraction is physiological, or pathological only in a secondary point of view.

It is true that Dr. Todd has referred the early and the tardy contractions in hemiplegia or cerebral paralysis to the operation of other causes, (see page 218,) but it is equally certain that Dr. Todd's views are erroneous; for both experiment and observation prove that no condition of the cerebrum, *limited* in its influence to the cerebrum, *can* induce spasmodic action.

An equal, or, rather, a double error is committed by Dr. Todd in reference to the action of strychnine (see page 227). It has been amply proved that strychnine acts on the spinal marrow, and only on the spinal marrow.

Throughout this inquiry it is essential, not only that our instruments should be identical, but that our terms should bear a meaning at once specific and accurate.

### III.—*The question submitted to fresh experiment.*

The questions now are:—

1st. Are there cases of paralysis in which the irritability of the muscular fibre is greater in the paralytic than in the unaffected part or limb?

2nd. Are there cases of paralysis in which the reverse of this obtains?

3rd. What are these cases severally and respectively? Are the former, cases in which the influence of the cerebrum *alone* is severed? and are the latter, cases in which the influence of the spinal marrow *also* is intercepted?

4th. Is the galvanic battery or trough of Cruikshank, cautiously employed, a fair test of the irritability of the muscular fibre in paralytic limbs? and, consequently, diagnostic of these two kinds of paralysis?

In the prosecution of these questions many precautions are required.

In the first place, it will always be observed that the patient is timid on the first application of the galvanism. The effect of surprise and of sudden sensation, in wincing, starting, &c., must be carefully distinguished from that of the galvanic influence on the muscular fibre.

2. The degree of the galvanic force should never be, because it never need be, such as to give "pain," far less such as to "jerk the limb out of the basin." Such violence must complicate the phenomena and confuse the results. The galvanic force should be the *mildest* which can produce an obvious effect.

3. The first effect of a paralytic seizure is one of shock, probably of diminished irritability of the muscular fibre. *Time* must be allowed for the restoration, as well as for the augmentation, of this property. It is, therefore, only after a certain lapse of time, that it is proper, or perhaps *safe*, to apply galvanism, especially if the patient be timid.

4. Within a very few days of the paralytic seizure, there is frequently a rapid and considerable recovery of voluntary motion; afterwards the recovery is both much slower and much less marked. The former is the recovery from *shock*, the latter diminution of the actual disease.

5. Lastly, in some cases there is *no* recovery. In these cases I think it probable that there may be no augmentation, perhaps no restoration, of the irritability of the muscular

fibre. In one such case, after the lapse of seven weeks, the muscles of the paralytic arm remained less susceptible to the proper galvanic influence than the unaffected limb.

Having made these preliminary and precautionary remarks, I proceed to the detail of a series of new experiments and observations. My task will then be terminated, and I trust the Society will be convinced that it was not without due caution and care that I gathered the facts together which I ventured formerly to lay before it, and that I drew my inferences from them. This is the reward of my labour,—that I have nothing to retract, nothing even to modify.

The cases in which I have carefully tested the irritability of the muscular fibre in paralytic limbs, before competent witnesses, are now almost innumerable: I may refer to the instances recorded in my former paper, read before this Society; to shorter papers published since, in my "Observations and Suggestions," Series I. p. 114, and Series II. p. 44; and to cases recorded in the *Lancet*. But I will not take up the time of the Society with any cases or experiments except such as I have observed *since* the publication of Dr. Todd's paper, and made, therefore, with tenfold care, if possible, to insure accuracy.

*Case* I.—The first case which I shall adduce is that of Mrs. ——, aged 35, affected with extreme paralysis of the right side of the face. The right eye could not be closed by the most strenuous efforts, but remained widely open; the right side of the face remained flaccid, whilst the left was drawn into forcible contraction on any attempt to speak, and under the influence of effort or emotion. The case was regarded by all present as paralysis of the facial nerve.

We applied galvanism from five, ten, fifteen and twenty plates of Cruikshank's battery: our surprise was great to observe that, although the left or unaffected eyelid was only, or most, moved, it was the muscles of the right or paralysed side of the face which alone were thrown into a state of contraction. The current was directed from the forehead to the chin, and from temple to temple, first from right to left, and

then from left to right; still the effect was invariably the same.

Now in every case of paralysis of the facial nerve, as in the case to be next noticed, it is the muscles of the unaffected side of the face which are most susceptible to the galvanic influence. In the present instance this was the case with the orbicularis only.

On further inquiry we found that the attack came on rather suddenly, with uneasy feeling—a sense of confusion—about the head, the noise as of a cricket in the right ear, and numbness in the right side of the tongue. It became plain, that it was a case of cerebral paralysis, and although its precise nature still remained obscure, two things were obvious enough: first, that it presents an instance of pure paralytic affection, uncomplicated with spasm, in which the fibre of the paralyzed muscles is more irritable than those of the unaffected muscles; secondly, as we shall see further immediately, that it is not a case of paralysis of the facial nerve; and thirdly, that the diagnosis was made out by means of the galvanic trough. For this case I am indebted to the kindness of Mr. Byam, of Welbeck-street.

*Case* II.—The second case which I shall adduce is that of a gentleman aged 30, who suffered from extensive suppuration on the left side of the neck and face, from exposure to the inclemencies of the weather in Australia; it left the left side of the face completely paralytic. The left eye gapes widely under the most strenuous efforts to close it, and the face is drawn to the opposite side in speaking, laughing, &c.

We tried the effect of galvanism, as in the preceding case: it was now the muscles of the right or unparalysed side which were excited, or most excited, to contraction, according as we employed a smaller or greater number of plates.

These experiments were repeated once a-week during several months, and therefore a great number of times, and before a great number of witnesses. There could therefore be no possibility of error. The patients are still under my care; and if a doubt exist in the mind, I can readily, as I

will most gladly, repeat the experiments in any manner that may be satisfactory to the Society.

*Case* III.—For this case I have to thank Mr. Archer, of Montagu-street. The patient, Mr. A. B., aged 48, has had two attacks of hemiplegia, one about eighteen months ago, the second three months ago. *The right arm* and *hand* are left greatly paralysed, and the muscles of the former are considerably emaciated.

We placed the two hands in one basin containing a solution of common salt, the two feet in another; we then passed the current from a common galvanic trough from basin to basin, varying the number of plates from about fifteen to twenty.

For the first few minutes the *left* or unaffected hand was most agitated at each completion of the galvanic circle, obviously the effect of *timidity*.

Afterwards, when the patient was re-assured, the *right*, or paralytic hand and arm, were distinctly moved by a number of plates which did not affect the left, and much more than the left, by a number which affected both. We first observed a finger of the paralytic hand to be moved; we then observed the muscles along the paralytic fore-arm to be raised at each repetition of the galvanic current, when no such phenomena were observed in the healthy arm and hand.

We now reversed the current; the effect was still the same.

The experiment was made on the 17th of December 1847. On the 21st it was repeated, with precisely the same effects, except that, from the commencement, the muscles of the paralytic arm were more contracted than those of the unaffected limb.

Mr. Archer was present, with Mr. Henry Smith and myself, on both these occasions.

*Case* IV.—On January the 31st, 1848, I galvanized W. M., aged 36, at Dr. Bennett's; Dr. Bennett, Mr. Le Gros Clark, and Mr. H. Smith, being present.

The patient had had six attacks, the first sixteen, the last

ten months ago. The left arm and leg were left greatly paralysed, especially the former; the right leg was also somewhat affected. The sight of the left eye was impaired, but there was little paralysis of the face; he could, however, close both eyes together, and the right *singly*, but not the *left*.

The muscles of the left arm were considerably emaciated, the other being finely developed; the hand could with difficulty hold his stick; the thumb was more paralyzed than the fingers, and drawn slightly towards the palm of the hand.

We first tried the effect of Cruikshank's galvanic trough with fifteen plates. The *left*, or affected hand, and especially the thumb, was slightly moved when no movement was observed in the right. With twenty or twenty-five plates, movements were observed in *both* limbs, but far more in the left than in the right, the fingers being moved and the muscles along the arm seen to contract.

We now tried the electro-dynamic apparatus of Hearder. The effects were reversed, being much more strongly marked in the sound than in the paralytic limb.

To this account I beg to append the following certificate, drawn up by Mr. Le Gros Clark. I leave it entirely without comment:—

"We have witnessed the experiments performed on Wm. Mackintosh, suffering from hemiplegia. In the first, Cruikshank's battery was used, in which there was very decided contraction of the flexors and pronators of the fore-arm of the paralysed side; the same effect was produced, but less apparently and to a more limited extent, on the sound side. In the second experiment, with Hearder's electro-dynamic machine, there was no question about the effect being much more strongly marked on the sound than on the unsound side.

(Signed) "James R. Bennett, M.D.
"F. Le Gros Clark.
"Henry Smith."

*Case* V.—My next case is as interesting, and in the same

manner, as my first. The result was unexpected, yet confirmatory of the general principle, and displays the galvanic influence once more as a corrector of a hasty and erroneous diagnosis.

The experiments were witnessed by Mr. Erichsen and Mr. Barlow, as well as by Mr. Henry Smith and myself.

The paralysis was confined to the left leg: it had come on gradually, and without any sudden seizure, fifteen months before, and had induced debility and atrophy of the glutei and of the muscles of the thigh and leg, with diminished temperature and circulation, the limb being thin, cold and livid.

I had inadvertently concluded that this case was one of partial *para*plegia, and therefore of spinal paralysis. I expected that the muscles of the paralytic limb would be less affected by the galvanic influence than those of the unaffected leg. It was just the contrary. On applying Cruikshank's battery, as usual, first in its mildest form, and then in that of gradually augmented power, the muscles of the paralytic limb, the tibialis anticus, the gastrocnemius, &c., were observed to contract, whilst those of the unaffected limb were unmoved, or far less moved.

When the power was considerable, the muscles of the paralytic limb were forcibly contracted, whether seen or felt, whilst scarcely a tremor was observable in the healthy limb.

On carefully interrogating the patient, it now appeared that in the commencement there had been slight tingling of the left hand, a fact not elicited before. It was plain that the case was one of partial *hemi*plegia.

We now exchanged the Cruikshank's trough for Hearder's electro-dynamic apparatus. *The effects were reversed!* The muscles of the unaffected limb were now moved or permanently contracted (according as the application of the machine was momentary or continued), when scarcely a movement was observed in the paralysed limb. The unaffected limb was jerked violently when the paralytic limb was scarcely moved.

No more glaring example can be given—1. Of muscles of

paralytic limbs with augmented irritability of fibre; 2. Of the diagnostic powers of the galvanic trough; 3. Of the wide difference between the effect of this apparatus and of the electro-dynamic machine.

This experiment was performed on the 8th of November 1847. It was repeated on the 9th. The results were the same.

I believe I need not adduce more cases than those already detailed, to prove the facts propounded in my former paper.

I will conclude this paper by one or two remarks on some suggestions that have been made as to other possible modes of explaining the phenomena which have been detailed.

I. It has been supposed that, in cerebral paralysis, the healthy limb may be, however unconsciously, restrained from moving by the volition of the patient. I do not deny that there may be some foundation for this remark, which was first fully and clearly pointed out by my acute friend, Mr. W. F. Barlow. But it is only necessary to be aware of the possibility of this influence to guard against it.

In the first place, there *can be* no such influence exerted on the features; for if there were, the face would be distorted, and this would be obvious to the most cursory observer.

In the second place, the volition may be suspended by causing the patient to let his hands hang down loosely, like a pendulum.

In a word, any mistake of this kind could only result from extreme inattention.

II. It has been suggested that the greater movement of the hemiplegic muscles may be the result of a reflex action.

But these movements may be limited to a single muscle, both in the face and in a limb, and are perfectly dissimilar from all reflex movements to the experienced eye; for these are movements of groups of muscles, and of a totally different character.

The idea is also negatived by a simple experiment: in no animal are reflex nerves more distinct, in every respect, than

in the frog. Now let a frog be decapitated, to remove sensibility, and let the nerves of one inferior extremity be divided, or, as far as possible, removed altogether, and let the two limbs be subjected to the same galvanic influence; in one there might be, but in the other there cannot be, a reflex action. Yet the irritability being alike, both are moved equally. This experiment Mr. Smith and I have repeated, with another object, many times.

To determine the question in regard to the human subject, I performed the following experiment: I first passed the galvanic current through the arms of a patient in the usual manner, the hands being in one basin, the feet in another, and observed the usual marked and greater effect on the muscles of the paralysed arm and fore-arm. I now passed the same current from the fingers and hand to the *wrist*, first of one, and then of both, sides, excluding the muscles of the arm and fore-arm: there were now movements of the wrist, hand and fingers *only*.

Now, as far as reflex actions are concerned, the arm was in the same condition in both experiments. The conclusion is obvious. Reflex action has nothing to do with the phenomena.

Indeed, as I have already said, the movements of the paralytic limb have not the slightest resemblance to those of excited reflex action.

In conclusion, I have no hesitation in declaring my opinion to be, that, if performed with due attention, neither volition nor reflex action has any influence on the results in these experiments.

Dr. Todd makes some remarks in reference to the influence, 1. Of the nerve imbedded in the surrounding tissues; and, 2. Of the degree of nutrition of the muscles themselves. These are questions requiring much further and careful investigation. I think the results will be at variance with Dr. Todd's conjectures.

*Postscript, July* 6, 1848.—I have this day been informed, by Dr. Golding Bird, that, in a series of experiments on children, at Guy's Hospital, he has found that, in cerebral paralysis, pure water being made the medium of conduction, the affected limb is moved by a degree of galvanic power which has no influence on the unaffected limb; and that the contrary holds in spinal paralysis. I trust Dr. Golding Bird will lay the results of his trials before the Society.

I may here remark, that in my first experiments, pure water was always used. The difference in the effect, between this and a solution of salt, is very great; and if, instead of using either, metallic contact be employed (by laying discs of metal, connected by wire, on each wrist, and then completing the circle), the result has been the same, in one instance, as that of the electro-dynamic apparatus; that is, opposite to that of the current retarded by using water as a part of the conducting circle.

Particular caution is required in making such experiments as those of Dr. Golding Bird: a single galvanic shock passed through the tissues induces an *electrogenic* condition; the muscles are less susceptible to the influence of this stimulus in a second or third shock, than in the first or second. When the limbs are subjected to the trial *singly*, this fact must be carefully borne in mind.

In addition to the testimony afforded by the experiments of Dr. Golding Bird, I may state, that since the date of the foregoing paper, I have continued to devote one evening weekly, aided by Mr. H. Smith and many others, to the subject, constantly with the same results.

CASE

OF

# EXTRA UTERINE FŒTATION.

By DONALD DALRYMPLE, Surgeon, Norwich.

Communicated by JOHN DALRYMPLE, Esq.

Received March 30th—Read April 11th, 1848.

The numerous cases on record of extra uterine fœtation may be classed for the most part under three heads: tubular, interstitial or parietal, and ovarian. Such are the cases reported by Dr. Oldham, in the Guy's Hospital Reports, and by Mr. Cobbold, in the Provincial Medical and Surgical Journal.

The case I now present differs entirely from the classes mentioned, and is remarkable in many points.

On the 26th of June 1847, I was called to see Mrs. A ——, a patient of the Norwich Lying-in Charity: being from home, my colleague, Mr. Master, attended for me, and found a woman with the uterus hanging out of the os externum.

The uterus was of considerable size (as large as the full grown fœtal head), of a red purplish hue, with a large ulcerated patch on its anterior surface. The woman stated that it had descended frequently before, but not to so great an extent, and that she was in the sixth month of her pregnancy: she also complained much of the movements of the child very high up in the abdomen.

The uterus was with some difficulty replaced, the recumbent position strictly enjoined, and an astringent injection prescribed.

I saw the patient on the following day. The uterus had

descended to, but not through, the os externum. On examining her with the speculum I found a large irregular patch of superficial ulceration on the anterior aspect of the womb, with a profuse yellow discharge. The cervix uteri was scarcely shortened; the os was patent to the admission of the forefinger, and presented none of the conditions of that part at the sixth month of pregnancy. On examining the abdomen I found an enlargement commensurate with her calculation, but reaching much higher and not so full over the pubes as usual: the swelling was hard and elastic, and I distinctly felt movements under my hand. The umbilicus was protruding, the areolæ of the nipples were dark and extended.

Mrs. A—— stated she was 32 years of age; that she had borne five children; had enjoyed very good health; and, though small-sized, was capable of great muscular exertion. She said she believed she became pregnant in the early part of January, as she had menstruated in the last week of the previous month.

She believed she quickened at the early part of April; but that shortly after, or about that period, she lifted, with one hand, a full pail of water from a tub, after which her feelings became different from those on former occasions.

Her husband stated, after his wife's decease, that during coition at the latter end of April, or thereabouts, during a violent movement, she suddenly felt something give way within her, and that immediately afterwards both of them perceived, on placing the hand on the umbilicus, a strange fluttering sort of movement, from which time she always referred the movements of the fœtus to a position higher than before. The woman, from motives of delicacy, had never mentioned this circumstance to me.

Shortly after this she first perceived the descent of the uterus, and was attended by a medical man (who told her she was pregnant) for four or five weeks, when, being unable longer to afford to pay for advice, she sought the aid of the parish surgeon. Upon the uterus descending nearly through

the os externum, *he* also told her she was pregnant, and ordered a pessary; but this occasioned so much pain that she could not wear it. The womb continued to descend sometimes, but was always returnable by her own efforts, till the time of her becoming my patient.

I saw her repeatedly; and, after a few days, the fœtal circulation was heard by Mr. Master and myself; it was most unequivocally made out, though in an unusual position, namely, high up, midway between the umbilicus and the right hypochondriac region; but we could nowhere find the placental bruit.

We decided that she was pregnant, and recommended her to wait the accomplishment of her time in a recumbent position, believing that, as pregnancy advanced, the disposition to prolapsus would subside. This, however, only partially took place; for, though the uterus did not escape through the external aperture, the cervix still lay on the perinæum.

On the 30th of September she sent for me, being in labour, and as I was again absent, Mr. Master kindly visited her. He found her suffering irregular pains, but there was no dilatation of the os uteri: the cervix was in the same state as in June, and there were no evidences of labour. I saw her at night; her pains had ceased, and with them all movements of the child. She said also that the pains had differed from labour pains, though unable to define the difference.

After a few days she diminished in size, her health improved, and she began to get about again.

At the expiration of a month, believing she might have made an error of a month in her reckoning, I again visited her. Her abdomen was smaller, and had lost much of its elastic feel; her general aspect was improved; she was able to get about better; she had lost all feeling of movement in the abdomen, and no sensation was conveyed to the hand. She had a slight sanious discharge, free from fœtor; her bowels acted regularly; she passed her water freely, but no change had taken place in the state of the os and cervix uteri, and occasional protrusion took place.

Mr. Master again saw our patient with me, and we in vain sought for the fœtal circulation we had heard in June and July. We placed her on her knees and elbows, but there was no displacement or falling forwards as of a mass or tumour. There was a circumscribed swelling, about the size of an infant's head, extending from the pubes to the right iliac fossa; and this was rather tender to the touch.

A week or two passed by without any change, and I proposed her going into the Norfolk and Norwich Hospital, for the benefit of further advice and treatment. This she did on the 12th of November, and I met her medical attendants there. The conclusions arrived at were very indecisive.

She remained in the hospital seventeen days, undergoing no treatment, but improving in health for the first twelve days, so that she was enabled to assist in the lesser labours of the ward. During the last three or four days of her sojourn she complained of pain and tenderness of the body; but, as her husband was ill, she left the house.

From this time she got rapidly worse, complaining much of the enlargement of the abdomen, which had assumed a very different shape, of great pain, shortness of breath, and cough. I did not see her; but the medical men, under whose care she now fell, treated with ridicule the idea of her previous or present condition being that of pregnancy.

She died on the morning of the 23rd of December; and in the afternoon of the same day I examined the body. Unfortunately I was unable to procure the assistance of Mr. Master, and was obliged to perform the inspection alone.

I carefully dissected back the integuments and muscles of the abdomen; but, after dividing the peritoneum, I did not enter the abdominal cavity, for there was a thick layer of soft yellow lymph, lining the whole surface of the peritoneum, and easily pulled off. On dividing this, out rushed a large quantity of thick sanious pus (seven or eight pints were saved and measured), which was not offensive nor putrid. Immediately across the abdomen, above the umbilicus, lay what at first sight I took to be a large purplish liver, with patches of

lymph upon it; but which, on further uncovering, I found to be the back and shoulders of a large full-grown fœtus, with patches of smegma.

The child was lying in a cavity, formed and bounded above by the intestines and the omentum adhering to the parietes of the abdomen, and below by the pelvis: this cavity was lined with a thick layer of soft yellow lymph, highly vascular in places; and in the iliac fossæ and over the psoæ muscles, thoroughly organized.

The child lay with the head occupying the usual position of the spleen, the vertex touching the five last ribs of the left side, with the scalp adherent to the insertions of the diaphragm; the feet were lying in, and adherent to, the right iliac fossa; and from both of these points it was requisite to dissect the attachments, in order to extricate the child.

I traced the umbilical cord, which wound round the loins of the child, obliquely down to a large mass occupying the region of the pubes, extending to the right iliac fossa, and touching the heels of the child. I was quite unable to extricate this mass, which, on section, presented the appearance of a deep maroon-coloured spongy texture, more like the lungs of aquatic birds than anything else I can compare it to.

I could not make out the uterus, so irregular and confused was this mass; and being unaided, and surrounded by a number of prying women, in a dark December afternoon, I was unable to bring away the mass to dissect it thoroughly. I, however, passed my finger into the vagina, and found the cervix uteri lying low down, unaltered in length or character from what it was six months before; and, on pushing it upwards, I found that I moved the whole of the before-mentioned spongy mass, which prevented my passing the cervix uteri up to its normal position.

The bowels were all driven upwards, and matted together by abundance of lymph: the liver, which was very large, but not structurally diseased, was driven up into the chest, so that its convex surface reached to the fourth rib, and ex-

tended across the chest till it touched the sixth rib on the left side, overlapping the stomach. The latter organ, which was very small, was driven up into the thorax behind the heart, which in its turn was displaced, so that its apex was opposite to, and touched, the centre of the sternum. The lungs were extremely compressed, but, like the heart, healthy.

The child, a female, was very large and well-formed, weighing eleven pounds and a half; and, though discoloured and purple on the back, was not at all decomposed: the corneæ were transparent, the nails perfect, the hands and feet purple.

The bones of the cranium, which was large, were loose and overlapping: there were patches of smegma, quite undecomposed, on many parts of the body. The umbilical cord required considerable force to break it, and the vessels were pervious.

During the whole of her illness, though she lay on her back from the 26th of June till the 3rd of October, her health did not apparently suffer; her appetite was good, her bowels were regular, and only twice was there occasion to pass a catheter.

The question naturally suggested by the foregoing history is,—whether the case is one of extra uterine conception, or of natural conception and subsequent escape of the fœtus into the cavity of the abdomen by rupture of the uterus. My own impression is, that the fœtus was retained in the uterus until the end of April; when, during sexual intercourse, a rupture of that organ occurred, through which the fœtus escaped: and I am led to this opinion, not from the history only, but from the fact that the cervix uteri arrived at the condition of the fourth month of gestation, and was never altered in its character afterwards.

If this conjecture be correct, at what period did the child die? If at the period of apparently commencing labour, namely, the 30th of September, is it possible that a dead fœtus could have remained in the abdominal cavity till the 25th of November, a period of fifty-six days, without exciting peritonitis, of which, from the first time I saw her till just before she left the hospital, she had not a single symptom?

We know that in cavities excluded from the atmosphere, a dead body will remain a long time without decomposing, but the adhesions at the head and feet of the fœtus, (which had so marked an influence in complicating the diagnosis,) would hardly have been formed round a dead body.

Is it possible that a fœtus could continue its dependent existence after the completion of its full term? If so, it might have continued to grow (as I believe it did) until it set up the acute inflammatory symptoms under which the patient sank.

Lastly, I may remark, how completely abdominal section would have failed, had a correct diagnosis been formed, and such an operation been attempted.

# OBSERVATIONS

ON

# SOME PECULIARITIES

OF

# POLYPUS OF THE UTERUS.

By CHARLES LOCOCK, M.D.,

FIRST PHYSICIAN-ACCOUCHEUR TO THE QUEEN,
PHYSICIAN EXTRAORDINARY TO THE QUEEN-DOWAGER,
AND
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Received March 24th—Read April 25th, 1848.

Upwards of twenty years ago, the late Dr. Robert Hooper showed me a preparation of a uterus, laid open, having a polypus not larger than a pea, with a short and narrow peduncle, attached within the cervix, high up, considerably within the os uteri, and not perceptible till the cervix was slit open. All the history which he could give me was, that the uterus was removed from the body of a young woman, who had died in the Marylebone Infirmary, from long-continued uterine hæmorrhage. The preparation was removed to the Museum of St. Thomas's Hospital, and is probably there still.

Several years after this, I was consulted by a medical friend about his own wife, who had had a large family, but was then suffering from frequent attacks of profuse uterine hæmorrhage. On examining the uterus, my first impression was, that there was nothing else discoverable but a relaxed condition of the organ; but finding the os uteri a little dilated, I passed a finger through it, and I distinctly felt the tip of a very small polypus, considerably within the cervix. It appeared impossible to remove a polypus, in such a situation and of so small a size, and I prescribed nothing beyond the ordi-

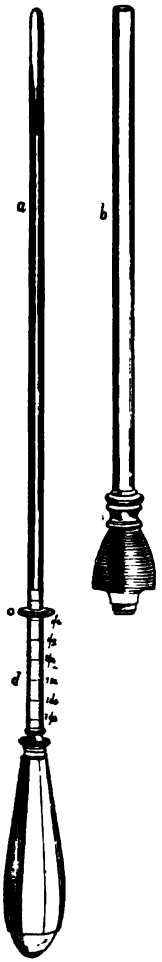
nary means to restrain the hæmorrhage, hoping that in time the polypus would become larger and more within reach. The patient went out of town for the summer months, but some weeks afterwards I received intelligence that the hæmorrhage had been alarmingly profuse, and the vital powers were much reduced. I advised repeated doses of the ergot of rye, hoping that by such a medicine the polypus might be brought more within the reach of instruments. The next night I went down to the neighbourhood of Rochester to see the lady, taking with me the necessary apparatus for removing the polypus, if possible.

I found her with a bloodless countenance, and a most feeble flickering pulse, and it seemed evident that if the hæmorrhage continued, she could not much longer survive. The ergot appeared to have had some effect upon the os uteri, which was thinner and more dilatable, but the polypus was scarcely more within reach than before, and all attempts to catch hold of it by forceps or hooks entirely failed. The only plan I could think of was gradually to pick off or dig through the polypus with my finger nail, and by perseverance I gradually succeeded: the patient perfectly recovered, and had another child a year afterwards.

I have since met with four cases of a similar character, where the polypus was equally small, and situated, in like manner, quite within the os uteri, attached to the cervix, one by a small peduncle, but the others with an attachment nearly as broad as the growth itself.

There is one fact connected with their detection which is worthy of notice. I never discovered the polypus in these cases, when I examined the uterus in the intervals between the attacks of hæmorrhage, either by the finger or the speculum. The os uteri was closed, the uterus having its natural feel, and I could detect nothing locally to account for the hæmorrhage. In the first of these cases, after I had made the examination in which I had detected nothing, I was sent for subsequently on account of the immediate alarm from the profuseness of the loss of blood, which was so excessive

that I was induced to plug the vagina. On removing the plug on the following day, I again examined the uterus, and finding then the os uteri more open and flaccid, I passed my finger through it, and discovered the polypus.




In the other cases, it was only by examining during the attacks of hæmorrhage that I was able to discover the small polypus that existed, as no vestige of it was perceptible after the os uteri had again closed, in the intervals of the attacks.

It was with exceeding difficulty, and after many failures, that I was enabled to remove the small polypi in three of these cases. I succeeded best by passing a stick of nitrate of silver (concealed in a canula, and made to slide out) through the os uteri up to the polypus, and holding it there for several seconds; but many successive applications were necessary, though very little pain or subsequent disturbance resulted. I often felt that if I had a finger-nail long enough, strong enough, and sharp enough, I might scoop away the polypus, as I had done in the case of my medical friend's wife, near Rochester. I therefore had an instrument made* (see figure), which acts on that principle, and which I have tried in the most recent of my cases, and found that with it I could easily and expeditiously cut away the morbid growth. It is simply a very small, fine, and sharp scoop (*a*), like a carpenter's gouge, inclosed in a canula (*b*), either to remain entirely within, or made to protrude beyond the sheath; the length of the protrusion being regulated by a screw (*c*) at the handle (*d*), which is graduated in quarters

* The instrument was made by Savigny, St. James's-street.

of an inch to the extent of an inch and a half. The gouge is passed through the os uteri up to the root of the polypus, still concealed in the canula: it is then pushed beyond the confines of the enclosing tube, for about a quarter of an inch, care being taken, by means of the screw, that it cannot pass beyond the desired length. The cutting edge is then pressed steadily against the base of the polypus, and the gouge is worked gently half round and back again once or twice, till it has cut through the object. In cases of polypus with a very small peduncle, the operation would of course be still more easy.

Without any intention to enter upon the general history or treatment of polypus of the uterus, I take this opportunity of noticing one or two circumstances connected with the subject, that I think deserving of the attention of the profession.

An ordinary polypus of the uterus, of a size varying from that of a hazel-nut to that of a large pear, is perhaps one of the simplest cases and the most easily managed in uterine surgery. For many years, in all such instances, I have never used the ligature, preferring to draw down the polypus by a pair of double hook forceps, and to excise it with the curved scissors or a bistoury. By this plan, so simple and so much more expeditious, all the mischief from the fetid and profuse discharges incident to the ligature is avoided; and I remember to have seen a case which very nearly proved fatal from the constitutional disturbance caused by the fetid matters poured out after a ligature had been applied several days, in the practice of the late Mr. Glen, of Brompton. In one instance of excision, my patient lost a very inconvenient quantity of blood, for several hours afterwards, an accident which has never since occurred to me, as I have from that time followed a suggestion of Sir Benjamin Brodie's, and have taken care to produce torsion of the arteries previous to excision, by twisting the polypus round several times, after fixing the double hook forceps.

In very large polypi, it may be safer perhaps to apply the ligature at first; but in two or three days, after the circulation through the polypus has been well strangulated, I have preferred to draw it down by means of the ligature, and then to cut through the neck above the noose. There are, however, cases beyond the reach of the scissors or the bistoury, where the polypus is so large and so blocks up the pelvis, that the neck cannot be felt. I have never yet met with one, however, where a ligature could not be applied, by passing it by means of the double canula of Niessens, as recommended by the late Dr. Gooch, high up in the pelvis, and even within the os uteri, till on tightening the cord it is felt to slip over the convexity and embrace the peduncle. The mere fact of not being able to feel the neck of the polypus or the os uteri, with the finger, is no insurmountable impediment to passing the ligature, although it often renders it exceedingly difficult, requiring much patience and careful management.

But there are cases which I have often found particularly troublesome, where instead of a polypus being too large for convenient removal, it is too small. These are instances where the polypi are easily to be distinguished by the touch, but are far too small to be noosed by a ligature, and often baffle the operator considerably, in attempting to seize them by the forceps or the hooks. I have lately found this difficulty vanish, by simply bringing them within sight, through a speculum, and for this purpose a bivalve speculum (Ricord's) is more convenient for subsequent manipulation, than a tubular one. I may here notice also, that in all the cases where I have thus brought a small polypus into view, whether they were attached to the os uteri or passed through it, they were of a dark red or purple colour, resembling a hæmorrhoid, and were perfectly different in hue from the neighbouring structure of the os uteri. When in full eyesight, nothing is more easy than to snip them off with a pair of curved scissors, with or without the assistance of the forceps, and I have usually afterwards touched the cut surface with the nitrate of silver.

I may mention as a singular fact connected with the history of large polypi, that some months since I removed one from a patient of Mr. Baker's, Bulstrode-street, as large as a fœtal head at seven months, where none of the usual symptoms of polypus had ever been noticed, neither hæmorrhage nor leucorrhœa, and where the polypus was discovered accidentally, from its pressure on the bladder leading to the necessity of the catheter.

Some of the observations I have thus ventured to submit to the Society have not, I believe, hitherto been publicly noticed, and may perhaps be worthy of attention, as conveying a few hints that others may find serviceable in practice.

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*Postscript, June* 15, 1848.—Since this paper was read before the Society, my attention has been directed to a most interesting and instructive publication on polypus by Dr. Montgomery, in the Dublin Quarterly Journal for August 1846. The cases of very small polypi described by me, so far differ from those mentioned by Dr. Montgomery, that mine were quite out of sight and out of reach, except during the relaxed state of the os and cervix uteri during the actual attacks of hæmorrhage. In his description of the appearances and colour of the small polypi, and in his plan of using the speculum for the purpose of removing the growth, he has clearly anticipated me.

# REMARKS

ON

# UNNATURAL DESCENT OF THE WOMB,

WITH A

## PROPOSED NEW INSTRUMENT FOR ITS ALLEVIATION.

By JAMES REID, M.D.,

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Received April 4th—Read April 25th, 1848.

Of all complaints peculiar to the female, unnatural descent of the womb is perhaps, with the exception of leucorrhœa, the one most frequently met with; and although it will come principally under the notice of the obstetric practitioner, still it must often present itself to those physicians and surgeons who do not practise in that department of the profession; hence, its treatment may be a matter of some interest to all.

In the present paper I propose, not to enter into the details of the different points connected with "prolapsus uteri," such as the causes of the altered position, &c., but to confine myself to cases of simple descent of the womb, dependent on relaxation, and uncomplicated with tumours, either uterine or ovarian, or with diseases of the adjacent parts; and in relation to these cases, to consider the principles of treatment and the mode of carrying them into effect.

The essential point to be attained is obviously not only to effect a replacement of the womb in its natural position, but more especially to retain it in that position, when so

replaced. Various remedies have been proposed to accomplish this object, but they are all open more or less to serious objections.

The recumbent position alone, as a means of cure, is quite insufficient in the majority of cases, and extremely tedious and unsatisfactory; but it is an excellent temporary aid to more efficient measures.

The great desideratum appears to be, that some *mechanical support* should be afforded, by which the womb may be retained '*in situ*,' whilst the female is at the same time enabled to assume the upright posture, and to undertake her usual duties.

The *requisites* of this support are, I think,—

1. That it should be *constant*, whilst the patient is in the erect position.

2. That it should be as *little prejudicial* as possible to the soft parts, with which it is in juxtaposition, whilst supporting them.

3. That it should not remain applied, *when unnecessary*, as during the night, when the patient is lying down.

4. That it should not interfere with the *proper functions* of the sexual organs.

5. That, on all the above accounts, the support should be *readily applied* or *removed*, by *the patient herself*, and, if possible, without the infliction of pain.

External supports applied to the abdomen or to the perinæum are not sufficient except in very slight cases of prolapsus.

Some *internal* support is absolutely requisite in the more advanced stages of descent of the womb.

It is well known that the upper portion of the vaginal canal into which the cervix uteri projects, is of much larger dimensions than the inferior part at the entrance; and, therefore, that any instrument used as a mechanical support for the womb, to be efficient, must necessarily be of dimensions equivalent to the upper part, and larger than the part near the vulva.

In almost all the instruments heretofore used for this

purpose, under the name of *Pessaries*, their introduction and removal have, on this account, been attended with some difficulty and much pain. This again has led to the injudicious practice of leaving the instrument in the vagina for weeks and months together, in order to avoid such difficulty and pain, and many serious results have been detailed by authors, as arising from this constant and long-continued pressure. With *married* females, there are additional and obvious reasons against such a practice.

It has been well remarked, "Plus ou moins altérables, plus ou moins fragiles, ces pessaires oubliés dans le vagin, y'ont maintes fois fait naître des excoriations, des ulcérations profondes, des fistules même, et ils ont nécessité des opérations douloureuses et difficiles, pour leur extraction complète."*

In corroboration of this fact I may mention that one of our eminent obstetric practitioners in this metropolis, who usually employs the boxwood globular pessaries, informed me that he had occasionally been obliged to break them in pieces, whilst in the vagina, by means of powerful bone-nippers, in order to effect their removal.

Even in the use of that form of pessary which I had always considered the safest and best, viz. the ovoid ring of elastic gum, I have known much severe suffering to arise, owing to the cervix uteri having swollen, whilst resting in the small central aperture of the instrument, to such an extent, that its extrication, and the removal of the pessary, proved a work of some difficulty, and of considerable pain to the patient.

Another evil often resulting from the large size of the pessary, is its pressure against the rectum and bladder, interfering with the proper functions of those organs, giving rise to much inconvenience, and, by inducing violent strainings, sometimes causing the forcible expulsion of the instrument, and the protrusion even of the womb itself.

Most of the stem pessaries have the additional inconve-

* Boivin et Dugès. Traité pratique des Maladies de l'Uterus.

nience of their globular extremities being so attached, as to render their introduction and removal still more difficult.

The inconveniences attending the use of pessaries will, I think, be avoided, and other advantages be gained, by the employment of the instrument I am about to describe.

It is allowed that the roof of the vagina requires support, in cases of prolapsus uteri, as much as the womb itself; but Professor Kilian goes a step further, and thinks that the *latter* organ may be left uncared for, and that all mechanical support should be applied to the upper portion of the *vagina alone*. He has, therefore, invented for this purpose an instrument very simple in its construction, to which, in a pamphlet lately published on the subject, he has given the name of "*elythromochlion*" or *vaginal supporter*.

"In its construction, (he says,) it is essential that a steel spring, carefully worked, of the dimensions of the instrument now shown, should have an equable and solid covering of elastic gum, so that it will resist the effects of the acid mucus of the vagina. The spring is generally to be preferred in proportion to its being soft and pliable: but these properties must not be given at the expense of durability. In this point, however, is the difficulty of their construction."

"The patient is placed in the horizontal position, and the practitioner holding the instrument in the bent state between his finger and thumb, so that its extremities touch each other, he separates the labia majora, and passes it up in the course of the transverse diameter of the vagina, to the upper part of the canal, allowing *then* the extremities to separate, so as to be in apposition with it on either side of the cervix uteri, but not touching the uterus itself. The arch of the spring is soon found to rest upon the os pubis."

In the autumn of 1846, Professor Kilian showed me, in the Clinical Hospital of the University of Bonn, one or two patients who were wearing the instrument, and who expressed a feeling of comfort from its use, removing and re-applying it themselves with apparent facility.

On my return to London, I had several of these instru-

ments manufactured, and employed them in six different cases of descent of the womb.

I found, however, that, as in the first cases related by Dr. Kilian, much pain within the pelvis was soon complained of by my patients, owing to the constant and *extreme* lateral pressure of the spring, caused by its tendency to re-assume its natural form; and this result unfortunately corresponded with the experience of Dr. Bäerman, of Coblentz, who informed me, that he likewise had used the instrument, but was obliged to discontinue it, on account of the pain it produced.

In two of my cases, also, an awkward accident happened to the patients, whilst wearing the instrument; for on some sudden movement in either case, the spring snapped asunder at the arch.

I then had the instrument altered, by causing the ends to be well armed with cork, before covering them with elastic gum, and by having the spring made in the semi-bent state, so as to prevent the full extent of the lateral pressure; but this contrivance failed at once, owing to the instrument no longer retaining its proper position in the canal, and being constantly liable to fall out.

I have been thus particular in describing Professor Kilian's "*vaginal supporter*," as it originated the idea of the instrument which I have now to submit to the notice of the Society, although the two differ in several material respects.

*The* WOMB SUPPORTER consists of two steel springs, very narrow at the ends, by which they are joined together, while each of the free extremities is about one inch and three-quarters broad, convex externally, and concave within, so as to admit of cork being attached to it, in order to give a greater surface, and thus, when covered with elastic gum, to prevent any sharp edge (see figures 1 and 2). The two narrow ends of the springs are fastened together by an intervening piece of ivory, or wood, so as to allow of the broader extremities separating from each other, to the extent of two inches and a quarter at their *external* surfaces. Being pressed together, these broader extremities form a comparatively small mass, which may be introduced into the narrow entrance of the va-

ginal canal. When within the vagina, they are allowed gradually again to expand, and are applied to either side of the cervix uteri. The instrument is then gently pushed up, until its narrow end is at the vulva, the womb being raised with it at the same time.

Fig. 1.

In the *second* form of the instrument, there are two small pulleys fixed to the internal surfaces of the broad ends of the springs; through these, a catgut passes, its two ends being drawn through an aperture in the connecting piece of ivory, where they are fastened to a button. By pulling this button, the separated extremities of the instrument are more easily drawn together. This contrivance facilitates the introduction of the instrument, and especially its extraction when required.

Fig. 2.

A loop of vulcanized India rubber is attached over the button, and through this a T bandage, ribbon, silk-handkerchief, or any other guard, can be drawn, and fastened before and behind, to the stays, for the sake of security, although, in some cases, I have found the instrument required no aid of this description.*

* The instruments were manufactured by Mr. Weedon, of Hart-street, Bloomsbury.

The intention of the uterine supporter might, perhaps, be best illustrated by its resemblance to the easy introduction of two *closed* fingers, within the vulva, which, after passing through it, are *separated*, and applied to either side of the cervix uteri, so as to hold it up in its proper position.

The instrument which I have thus described, for the support of the prolapsed womb, will, I think, be found to fulfil all the requisite conditions laid down in a former part of this paper. The utmost separation of one of the free extremities from the other, when placed at the upper portion of the vagina, is about two inches, giving a support quite sufficient for the purpose, and yet not presenting so great a diameter as that of many of the globe and ring pessaries: the objection to Professor Kilian's instrument is at the same time obviated, and I have not found any patient complain of pain arising from lateral pressure. This, however, is easily explained, by recollecting that the upper portion of the vaginal canal lies naturally in a flaccid state, easily admitting the presence of such an instrument, without any peculiar degree of tension being felt by its walls.

In some cases I have found much advantage, by tying loosely round the instrument a piece of lint, or linen rag, saturated with either anodyne or astringent lotion, this mode of applying such remedies being much more effectual than the temporary syringing.

I have, at the present time, several patients who are wearing the "supporter," with, they inform me, great comfort to themselves, and who find no difficulty in its introduction and removal. One of these cases was, at first, complicated with retroflexion of the womb, attended with great agony, and serious affection of the general health. By the use of the instrument proposed by Dr. Simpson, the uterus was restored to its natural shape, fortunately, in the course of a few days, as I was unable to continue the employment of the instrument any longer, owing to the severe pelvic pains which it caused. After it was removed, the "supporter" was used, since which period the patient has felt no pain whatever, and has

been able to walk out daily for some miles, which for months previously she was incapable of attempting.

I have employed the "supporter," also, with equal benefit, in another interesting case, where there was protrusion of the womb, containing a fœtus of nearly four months' development, with *total* inversion of the vagina. The uterus, with its contents, was replaced, the instrument worn for some weeks, and the case went on favourably to the full term of gestation.

A pessary, the invention of Dr. Bronard, has been shown to me by Dr. Locock, as somewhat on the same principle as the instrument described in this paper. It differs, however, materially, as will be observed on comparing them. The free ends, in Dr. Bronard's instrument, are placed *downwards*, so as to rest on the internal surfaces of the vulva, while the ivory ring acts as a support to the womb.

I have not, in the preceding observations, alluded to the different surgical operations proposed for the obliteration or contraction of the vagina, in order to effectually prevent descent of the womb, as I presume that they would not be considered as adapted to such cases as those I principally refer to, viz. such as occur in women at the child-bearing time of life. Artificial contraction of the vagina, and of the vulva only, as proposed by Fricke, D'Outrepont, and Berard, and the various methods brought forward in our own country, by Dr. M. Hall, Mr. B. Phillips, and others, would, of course, have reference only to those cases in which mechanical support had failed.

CONTRIBUTIONS TO THE STATISTICS

OF

# VALVULAR DISEASE OF THE HEART;

WITH ESPECIAL REFERENCE TO AFFECTIONS OF THE SEVERAL ORIFICES,

AND

THE PARTICULAR EFFECTS OF CERTAIN RECOGNISED CAUSES.

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In presenting these remarks on the subject of valvular disease to the Medico-Chirurgical Society, I feel it due to myself to state that the inquiry was entered into with no view to publication, but merely to ascertain facts for my own instruction, which published works on this subject did not supply. But having found that other results began to develop themselves, and having formerly experienced the need of such statistical information as the present paper contains, I have been led to hope that it might be useful to others. To render the results of the investigation more readily available, I have placed in a tabular form a short resumé of the more important pathological facts observed in various organs in the several cases analysed. These facts will, I trust, carry with them the more weight as they are put forward on the authority of Messrs. Hewett and Pollock, the successive curators of the Museum at St. George's Hospital, by whom all post-mortem

examinations there have for some years been conducted and recorded.

The cases included in the Table occurred during the last two years, when a constant personal examination of cases in the medical wards necessarily threw much light upon the results afterwards ascertained in the dead-house. But as my object has been to obtain correct general statistics, I have not limited myself to those only which came under my own observation, but have endeavoured, by a careful perusal of all the cases, to ascertain in how many instances valvular lesion occurred; to compare, one with another, the various forms it assumes; and to detail in connection with it the morbid changes in other structures, which have reference more or less defined to disease within the heart. And here let me also acknowledge my obligation to the medical officers of St. George's for the permission kindly accorded me to publish such facts as are derived more directly from the Museum Records of that institution, in which a mass of materials of a highly interesting character have been accumulated for several years past.

The whole number of deaths in the hospital during the period above referred to was 535; the condition of the organs of circulation was ascertained in 419 instances, and among these there were seventy-nine cases of valvular lesion. These have been arranged in the Table, according to the ages of the patients. The first two columns exhibit the particular condition of either valve which had become the subject of disease; the others show the number of cases in which atheromatous disease was found at the root of the aorta,—the cases in which the previous history of the patient decided whether he had ever suffered from an attack of acute rheumatism, or the contrary,—the changes in the muscular structure of the heart,—the instances in which the recent effusion of lymph or the persistence of old adhesions indicated inflammation of the serous membranes within the chest,—and those in which any change was found in the structure of the kidney. Other lesions are occasionally mentioned, and the chief cause of death is stated.

The term "*fibrinous deposit*" has been generally employed in the Table, as distinctive of that condition of the endocardial membrane which we are in the habit of considering as the result of acute inflammation: it is not intended to imply an adoption of the theory which attributes its presence to deposition from the blood, in preference to that which derives it by exudation from the lining membrane. It occurs sixteen times among the first eighteen cases, reaching to the age of 34, and is only five times mentioned among the remaining fifty-one cases. In fourteen instances previous valvular disease had existed, while in seven the fibrinous deposit on the valve is the only condition of disease. The details of these cases will be considered under other heads; but it cannot fail to be remarked, that whatever circumstances may co-operate in the development of this condition, the presence of fibrinous deposit is more influenced by the age of the patient than by any other cause whatever.

*The valves affected* in the seventy-nine cases detailed in the Table are,—

In 36 cases, the aortic and mitral valves, simultaneously; or, 45 per cent.
In 26 „ aortic valves alone; or, 33 per cent.
In 17 „ mitral valves alone; or, 21 per cent.

These numbers may be taken as pretty correct representatives of the relative proportions of valvular disease in general; for on a larger survey, extending to nearly 200 cases, I find the numbers are—

46 per cent. for the aortic and mitral together.
32 „ „ aortic alone.
22 „ „ mitral alone.

100

Or, taking for our standard of comparison the whole number of post-mortem examinations, in which the condition of the heart is reported, viz. 419, as before stated, we obtain—

18·8 per cent. of valvular disease;

and—

8·6 per cent. of disease of the aortic and mitral valves simultaneously.
6·2 „ „ „ aortic alone.
4·0 „ „ „ mitral alone.

18·8

Among the 419 deaths from all causes in the hospital, no fewer than 113 individuals (about twenty-seven per cent.) are reported to have exhibited traces, more or less marked, of *atheromatous disease* either on the valves themselves or in their immediate vicinity at the origin of the aorta. The researches of various pathologists have sufficiently proved this disease to be one chiefly of advanced life. And here it need only be stated, by way of illustration, that during the two years there occurred—

1 case at the age of 6
1 „ at the age of 12
1 „ at the age of 19
13 cases from 20 to 30
22 „ from 30 to 40
19 „ from 40 to 50
36 „ from 50 to 60
13 „ from 60 to 70
7 „ above 70 years of age.

Comparing these numbers with the proportion of deaths at corresponding ages during the same period, I find that amongst all the patients dying in hospital the proportion exhibiting traces of atheromatous disease in the immediate proximity of the heart was at the different ages as follows:—

from 20 to 30 . . . . 12 per cent.
from 30 to 40, and from 40 to 50, each 21 per cent.
from 50 to 60, and from 60 to 70, each 43 per cent.
and above 70 . . . . 54 per cent.

Valvular disease is superadded in about two-fifths of the cases of atheroma, but in little more than half of these is the valve found in a condition of atheromatous degeneration.

Among the cases recorded in the Table, we find twenty-eight examples of atheromatous disease affecting valves, fourteen of which exhibit atheroma of the root of the aorta. There are also twenty-four cases of atheroma of the aorta, in

which the valvular affection was of some other nature. We have, therefore, fifty-two examples of atheroma among the seventy-nine cases of valvular disease, and, as before stated, 113 altogether for the two years. And taking, again, as the standard of comparison, the 419 post-mortem examinations, we obtain the following relative proportions:—

27 per cent. of atheroma on the valves, or in their immediate vicinity.
12·24 per cent. of atheroma, conjoined with valvular disease.
3·34 per cent. of atheroma of the valves, with similar condition of the aorta.
5·73 per cent. of atheroma of the aorta, with some other form of disease in the valves.
3·34 per cent. of atheroma of the valves, the aorta being healthy.

The twenty-eight cases of atheromatous valves consist of—

4 affecting equally the aortic and mitral valves.
12 affecting the aortic valves.

of which
- 1 was associated with fibrinous deposit on the mitral valve.
- 6 „ with thickening of the mitral.
- 5 „ with no form of mitral disease.

12 affecting the mitral valve—

of which
- 1 was associated with fibrinous deposit on the aortic valves.
- 2 „ with thickening of the aortic valves.
- 9 „ with no form of aortic disease.

In two of these cases, fibrinous deposit on the one valve corresponds to an atheromatous condition of the other. Nor is this association of old atheromatous disease, with recent inflammatory action, one of very rare occurrence. There are altogether eight such instances. In addition to the two just mentioned, one case exhibits atheromatous and fibrinous deposits on both sets of valves; another, atheroma of the aortic valves accompanied by fibrinous deposit on the aorta itself. Atheromatous and fibrinous deposits on the aortic valves are associated, in a third case, with thickening of the mitral; while the same combination of disease in the mitral is, in one instance, conjoined with thickening of the aortic valves, and

exists in two more, without other cardiac lesion. In several of these cases, other acknowledged causes of cardiac inflammation had been present, which might serve solely, or conjointly with the atheroma, to excite the inflammatory action of which traces are found after death. In one, recent pleurisy; in another, pericarditis; in a third, granular degeneration of the kidney; and in two others, inflammations in other organs,—prevent our assigning too great importance to the previously atheromatous and contracted state of the valve; but in others no cause can be assigned. And I may refer to Nos. 7 and 18 as being instances of this nature, and offering a fair presumption that the inflammatory condition was in great measure brought on by the previous condition of the valve, which was such as to offer great impediment to the due action of the heart.

Another set of cases, of an opposite character, might also claim our attention, in which atheroma seems to have been developed in a valve previously thickened, contracted, or even cartilaginous; but this will better fall to be considered after the cases commencing in inflammation. And I would now only advert to the fact, that the results of this analysis are opposed to the statement made by several pathologists, that the mitral valves are more liable to atheromatous disease than the aortic; the only difference in the cases I have examined being, that when the mitral valve is affected with atheroma, the aortic valves are more frequently found free from other forms of disease, than the contrary.

There are only fifteen cases in which a distinct account was obtained from the patient, of his having undergone, at any previous period, an attack of acute *rheumatism*: in many of the others, it was equally ascertained that he never had done so,—in some the fact was doubtful, and in others it had never been inquired into. We may suppose that in many cases, in which merely slight thickening or opacity of the valve was found, giving no evidence of their unsoundness during life, or where the attention was directed to some other ailment, wholly independent of the central organ of the circulation,

which ultimately proved fatal, the affection of the valve might be due to a previous attack of acute rheumatism; although, having been overlooked during life, its cause had never been inquired into: and this is particularly true of patients dying in the surgical wards. In addition to this, if we consider the difficulty of obtaining a distinct account from the patients themselves, of any previous illness, or of the origin of their present ailments, it is at least probable that all the cases due to this cause are not stated as such.

This question becomes important, when we find that the fifteen cases consist of—

13 of affections of the aortic and mitral valves together,
1 „ aortic valves alone, and
1 „ mitral valves alone;

which affords a striking contrast to the statistics of valvular disease in general, already given. But it is remarkable, that in going back over two or three years previous, a similar result is obtained; and that of thirty-five cases ascribed to the consequences of rheumatic endocarditis, there are—

28 of affections of the aortic and mitral valves together.
3 „ aortic valves alone.
4 „ mitral valves alone.

One possible source of fallacy it may be well to advert to. From the nature of the case, it must be evident, that the majority of those to whom the question had happened to be put, were patients in whom the affection was so pronounced, as to leave no doubt that the valves were unsound during life, and, therefore, many, or most of them, were cases which proved ultimately fatal, chiefly in consequence of conditions arising out of that unsoundness. But in other cases, fatal in consequence of similar conditions, likewise traceable to disease of the heart, in which acute rheumatism had not existed, the same proportion does not hold. Of the fifteen rheumatic cases, nine proved fatal, from disease directly connected with unsoundness of the heart; of which there were—

8 cases of disease of both aortic and mitral valves.
1 case „ the aortic valves alone.

The other six were complicated with diseased kidney, and albuminuria. During the same period, I find twenty-six cases recorded, in which the cardiac disease was equally pronounced during life, of which nine were connected with albuminuria; the remaining seventeen consisting of—

| | | |
|---|---|---|
| 7 | cases of disease of | the aortic and mitral valves simultaneously. |
| 4 | ,, | aortic valves alone. |
| 6 | ,, | mitral valves alone. |

No doubt therefore remains, in my own mind, that cases of cardiac lesion due to rheumatic endocarditis are peculiarly liable to simultaneous affections of both sets of valves.

Almost all the cases of morbus cordis found in connection with rheumatic fever, prove fatal at a comparatively early period of life. Ten of the first seventeen cases in the Table are stated to have had attacks of it, and to have died at ages from twelve to thirty-one. In only one of these cases was the rheumatic fever recent; in another case, a recent attack supervened on one of old standing, and no new inflammation was excited in the endocardium; and in a third case, purulent inflammation of the joints was present, without endocarditis, and a history was given of an attack of acute rheumatism, some years previously. The five cases occurring at later periods of life, all similarly point to attacks undergone some years prior to the period of their death, and in one only was there severe lesion of the valves of some standing (No. 24); in three others, the pericardium was adherent; and one case (No. 37) I am inclined to view as a mere coincidence, since the rheumatic fever had existed sixteen years previously; the pericardium was not adherent, one of the valves was atheromatous, but the valvular lesion was nowhere of great extent, while there was also granular degeneration of the kidney.

It must be remembered that acute rheumatism is essentially a disease of youth. During the two past years at St. George's Hospital, one patient was admitted labouring under an acute form of the disease at 55 and one at 50 years of age.

Between 50 and 35 there were 22
„ 35 and 25 „ 50
„ 25 and 15 „ 71

Under 15 there were seven, of whom the youngest was 10 years of age. This has of course only an approximative value, as we know that children are liable to its attacks at a much earlier period, and I have every reason to believe that the number under 15 ought to be greater, but that they are more seldom brought to the hospital at that age. I would here, in passing, call attention to the fact, that while during two years 152 patients laboured under this disease in the hospital, excluding the subacute, gonorrhœal and chronic forms, only fifteen cases of endocardial affections, in which a history of acute rheumatism was obtained, were found on post-mortem examination during the same period. And if to these be added all the doubtful cases in which the origin was not known, and the chief lesion was not atheromatous in kind, the number only amounts to thirty-eight altogether, of which fourteen were complicated with diseased kidney.

A previous attack of acute rheumatism, complicated with cardiac inflammation, would seem to confer a predisposition to suffer from subsequent endocarditis, even though the rheumatic disease should not again manifest itself in the joints. Eight of the first ten rheumatic cases present evidence of recent endocarditis. In one of these, as already mentioned, there had been a recent attack of acute rheumatism. In another, the patient was admitted labouring under a severe form of pneumonia, terminating in disintegration of the structure of the lungs. In a third, granular degeneration of the kidney was found. But in the other five, the chief ailment during life, and the principal cause of death, was referrible to the heart itself; three were complicated with dropsy. Of these—

2 without dropsy had recent pericarditis.
3 with dropsy had { 1 pericarditis and pleurisy.
1 pleurisy.
1 pneumonia.

A further confirmation of this predisposition would seem to

be derived from four cases of fibrinous deposit found on other portions of the endocardial membrane, which all occurred in cases of old rheumatic fever.

In nine of the fifteen rheumatic cases, endocarditis was present at the time of the patient's death. The majority of these gave evidence of previous disease. Two were accompanied by atheromatous deposit in an advanced stage. In the other six cases, the valves were in two atheromatous, and in the remainder merely indurated and contracted. In all the cases in which fibrinous deposit was present, both valves were affected by some form of disease; the two examples of rheumatic affections of solitary valves being found among those of old standing only.

The column following that devoted to the report upon acute rheumatism states in general terms the alterations found in the *muscular structure of the heart*, the details of which do not seem of sufficient interest to detain us at present. Hypertrophy, dilatation and atrophy are equally found mentioned as the consequences of severe lesion of the aortic and of the mitral valves, and of adherent pericardium; and sometimes would seem to exist in a considerable degree of development, with a condition of valves in no way proportionate to the muscular changes.

The two subsequent columns are devoted to a detail of those cases in which there were indications of recent *pericarditis* or *pleurisy*, and those in which old adhesions gave evidence of previous inflammations. There are fifteen cases of recent pericarditis among those of valvular disease; in seven of which, the patients had at some previous period suffered from rheumatic fever; in six of the remaining eight, this had certainly never been the case; in one it is uncertain, and in one unknown. Nine of the fifteen cases are associated with fibrinous deposit on the valves, and one with similar deposit on the lining membrane of the aorta, without its being found on the valves. There are also nine cases of old adhesions of the pericardium, six of rheumatic origin, two non-rheumatic, one of unknown origin. It has formed no part of my plan to discuss the subject

of pericarditis, and it is only introduced here, with a view to examine its bearing upon valvular disease. The uncertainty still hanging over those white patches so often found on the surface of the heart,—the difficulty of enumerating every instance, or of wholly excluding it as evidence of inflammation, as well as the question, how far all trace of pericarditis may be removed, seemed to justify the course I have adopted. Several of the cases which combined pericardial with endocardial inflammation bore evidence from examination during the patient's life that the affection of the pericardium was subsequent to, and consequent upon, the inflammation within the heart; while in some, a general cause seemed to operate in developing both simultaneously, and each independently of the other; and in others the inflammation being propagated from neighbouring parts, may be presumed to have travelled from without inwards, and endocarditis to have supervened upon pericarditis.

Seven of the fifteen instances of recent pericarditis, and five of the nine of old standing, are associated with similar conditions of the *pleura*. There are also seven cases in which recent *pleurisy* is associated with fibrinous deposit on the valves: in four of these, pericarditis was also present, and in three, the pericardium was unaffected. Numerous other complications were present, and in three only were the symptoms referrible to the lungs and pleura at all prominent—so that I am unable to trace any such definite association between pleurisy and endocarditis as clinical observation led me to anticipate. Several instances are recorded of old pleuritic adhesions, in which slight thickening of the valves from previous inflammation was found, without any other lesion sufficient to account for its origin; but in all it will be observed that the affection of the valve was slight, and they commonly occur among persons in advanced life. Pleuritic adhesions are mentioned in thirty-four of the cases of valvular disease; and—

In 21 are associated with disease of the kidney.
In 2 „ with rheumatic fever.

Of the remaining eleven cases,—

3 were instances of atheromatous disease of the valves.
8 „ simple thickening.

Deviations from the healthy and normal condition of the *kidney* are noticed forty-one times in the Table:—

In 28 cases the disease is granular degeneration.
5 „ the kidney is "large and mottled."
1 „ it is "mottled, small, and the cortical structure wasted," as in granular degeneration.
3 „ it is congested.
2 „ it is coarse.
1 „ it is fatty.

In the remaining case, one kidney had a yellow patch on its surface. During the same period, granular degeneration was observed altogether in fifty-nine cases; the kidney was large and mottled in twenty-one instances; and in eleven, it was mottled and atrophied. In nine of the last number it was also granular, and five of these were coincident with valvular disease, so that I am inclined to place the other two, in which the surface was not granular, in the same general class of atrophied kidneys, in opposition to those which are increased in size in the diseased state. The other conditions need not at present occupy our attention. Four times in the Table, kidneys affected by other forms of disease are stated to have contained cysts; but in seven instances of simple cysted kidney, occurring during this period, the valves were unaffected. It is remarkable, that while of sixty-one cases of atrophied kidney, twenty-nine are coincident with valvular disease; only five cases in twenty-one of those in which the kidney was "large and mottled" present examples of endocardial affections; very nearly fifty per cent. in the one condition, and scarcely twenty-five per cent. in the other. Among so large a number of cases, this result must be looked upon as something more than a mere accidental circumstance, and derives increased importance from the doubts entertained by some pathologists as to the identity of these two forms of disease, which have been supposed to be only different stages of the same affection.

Among the twenty-nine cases of atrophied kidney, there are five examples of recent endocarditis, of which—

1 is connected with previous rheumatic fever.
2 „ with a previously thickened state of valve.
2 „ with no other cause.

In three of these, old adhesions of the pleura were found; and in one, recent pleurisy—in another, recent pericarditis, were also present; but in all, the disease of the kidney had been recognised during the life of the patient by the presence of albumen in the urine: and, from a careful examination of the cases, I think I am justified in asserting that it was the chief cause of the lesions found after death. For although we have seen reason to believe that a mutilated or inefficient condition of a valve may excite endocardial inflammation, still in the cases before us the affection was scarcely of such extent as to authorise such a belief, and was of minor importance in comparison with the condition of albuminuria; and at least the two last are free from any such ambiguity. The remaining twenty-four include—

2 cases connected with rheumatic fever.
10 „ with an atheromatous state of valve.
1 „ with atheromatous dilatation of aorta.
11 „ with no other direct cause of disease of heart, except pleuritic adhesions.

In three only of the ten instances complicated by an atheromatous state of valve does that appear to have been unaccompanied by inflammatory thickening; in some the condition of the valve was such as to afford very clear evidence that inflammation and thickening had preceded the atheromatous deposit, while in others it could not be ascertained which was the primary lesion. In six of those cases which I am inclined to attribute to disease of the kidney as the predisposing cause of the affection, pleuritic adhesions were found: and while on the one hand it is to be considered that endocardial inflammation may probably be excited by pleurisy, it is to be remembered on the other, that it is in many instances due to

renal disease, and is liable to occur in the course of renal dropsies, without any assignable cause.

The five cases in which valvular disease was coincident with the large and mottled condition of kidney, consist of—

3 of acute endocarditis
- 1 complicated with calcareous deposit.
- 1 ,, with previous rheumatic fever and cellular inflammation.
- 1 complicated with severe pleuro-pneumonia.

1 of simple atheroma of the mitral valve.

1 of thickening and ulceration connected with no other direct cause of cardiac disease.

Whatever influence may be assigned to the condition of the kidney as predisposing to cardiac disease, it is worthy of remark that in each of the cases of recent endocarditis just enumerated, the complications are such as we have seen associated with the same form of acute disease when the kidneys were healthy, which cannot be said of all the instances of granular degeneration. In the first case only (No. 13) was disease of the kidney indicated during life: there had been excessive hæmaturia of but short duration previous to admission: the calcareous deposit on the valve was of old standing, and there were old adhesions of the pleura and pericardium. In the two others (Nos. 41 and 55) severe and fatal inflammations were present, and are noticed as of primary importance in causing the patient's death: in fact, there was no symptom to call attention to the condition of the kidney. In one of them there had also been a previous attack of acute rheumatism, which, as we have seen, has a tendency to confer a predisposition to subsequent attacks of endocarditis, and the pericardium was adherent probably from this cause.

The first of the two cases without recent endocarditis (No. 22) cannot in any way be attributed to disease of the kidney. The other (No. 66) is more doubtful. This patient had happened to have been in the hospital twelve months previously with common continued fever, from which he recovered completely, but during the continuance of which a bruit was discovered accompanying the first sound of the heart over the

aortic valves, without any evidence of the hypertrophy which was so marked on his second admission; and during the intervening period he alleged that he had suffered from gout; the urine was albuminous. The consideration of these cases is not unimportant; for although the most direct evidence of the connection between endocarditis and particular forms of renal disease must undoubtedly be derived from those in which the former affection is quite recent, still we should also expect that, if it be of frequent occurrence during their continuance, traces of its previous existence will be left in thickening and contraction of the valves after death. And in comparing these two forms of disease, we find that, while contraction with thickening of the valve exists in numerous cases of "granular degeneration," only one ambiguous instance is recorded as coincident with a "large and mottled" kidney, a result which agrees with the fact, that endocarditis occurs in the former without complications, and is not found in the latter, except under such conditions as would seem to develop it in healthy kidneys. At the same time it is right to observe that there are, in the Table, but three cases of endocarditis between the ages of 45 and 55; and that two of these are coincident with "large and mottled" kidneys, and one with granular degeneration, whatever other cause may have been in operation; while on the other hand, there is scarcely a larger proportion of cases of valvular disease coincident with mottling degeneration than is found among deaths from all causes in the hospital.

Of the cases in which evidence of recent endocarditis was found, three remain which have their origin in none of the causes hitherto specified. The first of these (No. 1) derives importance from its being the only case recorded in the Table, in which a general condition of inflammatory disease is accompanied by inflammation of the endocardium, without the intervention of any other assignable cause, and from its thus justifying the assumption already made, that even where such complications are present, a reference to the history of the case may induce us to exclude them as causes of the endocarditis which has been found. A mark of doubt is placed after the

statement that the patient, in this case, never had suffered from rheumatic fever, solely because he was said to have complained of aching pains in his limbs a day or two before the accession of the acute symptoms, although none of his joints had ever been swollen or red.

The other two (Nos. 3 and 28) have one feature in common; they present the peculiarity of having only two aortic semilunar valves. Two similar instances occur in the Table, exhibiting other forms of valvular lesion, and I am not aware that, during the two years from which the cases are selected, any instances of this abnormal conformation occurred unconnected with endocardial disease. In none of them was the mitral valve at all affected, none gave a history of previous rheumatic fever, in none was any form of renal disease present, and in all, while two of the valves were unusually developed, the third was either quite rudimentary or entirely absent; and I am inclined to attribute to the congenital malformation the subsequent development of cardiac disease.

The four cases consist of—

2 instances of recent endocarditis.
1 „ of inflammatory thickening with ulceration.
1 „ of calcareous deposit.

The first occurred in a boy of 14 years of age, who was admitted into the surgical wards with diffuse cellular inflammation, commencing at the ankles and extending up the legs to near the knees, and terminating in the formation of pus of a fetid character, which was found burrowing among the muscles of the leg: secondary abscesses formed in the lungs; and pus was also found in one of the ankle-joints which was opened. In this case, the exciting cause of the endocarditis was manifestly that of general inflammation, but it is very remarkable that this is the only instance under the age of 25 in which one set of valves alone is affected, and that these were the subjects of congenital malformation. The whole history of the case forbids its being regarded as allied to acute rheumatism, although the inflammation began in the neighbourhood of the ankle-joints. The other case of endo-

carditis occurred in a man aged 39, who, though a carrier, had never experienced any dyspnœa or irregular action of the heart, nor any incapacity for exertion, till four months previous to his admission, when, to use his own expression, he caught a "violent cold," with sharp pain in left side, for which he was blistered, &c. Dropsical symptoms had commenced three or four weeks before his admission, and a rough "bruit" accompanied both sounds of the heart over the aortic valves. He had had no other previous illness which he could recollect. On post-mortem examination no lesion of any importance was found, except the "rudimentary state" of one of the semilunar valves, and extensive atheromatous deposit in the aorta, with destruction of its lining membrane. There was considerable congestion of the lungs, with pulmonary apoplexy, and a small tubercular mass occupied the apex of the left lung.

In No. 38, the two semilunar valves were much thickened from previous inflammation, and one was ulcerated quite through, so as to permit free regurgitation of the blood; the lungs were, as in the former case, congested, with some pulmonary apoplexy. The history of the case was very similar to the preceding, palpitation commencing three or four months previous to admission, without his having had any preceding illness, and dropsy supervening, on account of which he was led to apply for admission into the hospital. The other case (No. 20) died in consequence of the effects of delirium tremens, and I have therefore no history of the cardiac affection.

Before leaving the subject of endocarditis, perhaps I may be permitted to allude to another case (No. 6), which derives interest from the complication with jaundice occurring a few days before death.—A girl aged 18, pale and cachectic, said to have been subject to palpitation of the heart from a child, had an attack of acute rheumatism, with pain in the chest, four months ago, since which time the cardiac symptoms have much increased. I need not detail all the symptoms: there was evident enlargement of the heart, with a mitral murmur.

Three or four days after admission, constant vomiting commenced, and continued with no intermission till within one or two days of her death. Jaundice supervened two or three days after the vomiting, and the affection of the heart became evidently and painfully increased. Her condition was such as to preclude any minute examination of that organ, but a week after admission pericardial friction was very distinct, and obscured the other sounds of the heart.

Twelve days after admission I made the following note:—"She is lying almost unconscious, with a brightly yellow skin, only disturbed by frequent efforts to vomit: the præcordial region has become more prominent and full since admission; the heart's action is very violent and irregular, shaking the whole upper part of her body, having evidently become much more laboured, as the jaundice has supervened." Erysipelas of the face came on a few days before death, with an inflamed and ulcerated condition of the fauces and pharynx.

Post-mortem examination showed the jaundice to have been dependent on disease of the liver, with obliteration of the secreting apparatus. One kidney had a patch of yellow discoloration, covering about a fifth of its surface, which penetrated to some depth into the cortical structure. The mitral valve showed traces of disease of long standing, and also of recent endocarditis; and the aortic valves had slight fibrinous fringes. The pericardium contained several ounces of serum, with flakes of lymph suspended in it.

I cannot state positively whether albuminuria existed during life, but I believe not; however, the point of interest in this case is, that the predisposition to inflammation of the endocardium being given by previous disease of the mitral valve, there seemed to be a connection between the sickness and the development of endocarditis and pericarditis, and a mutual dependence of both these on the structural disease of the liver, and the presence of bile in the blood. Jaundice would seem, on the other hand, to be sometimes produced in the course of an illness, of which the most marked feature is disease of the heart, in consequence of secondary congestion

of the liver, from impediment to the circulation, particularly when this extends to the right side of the heart. Were I to allow myself to speculate on blood-poison as a cause of endocarditis, of which acute rheumatism and granular degeneration are supposed to furnish us with examples, I might inquire why it is that in the one the inflammatory action is so liable to extend to both sets of valves, while the other does not exhibit any marked deviation from the ordinary statistics which I have obtained for all forms of cardiac lesion together? whence the liability to a recurrence of endocarditis is derived, when no subsequent affection of the joints has been observed? or why, in the last stages of granular degeneration, when epilepsy or coma marks the transmission of the poison to the brain, recent inflammation is so rarely found, and evidence of previous disease is of such constant occurrence? But for the present it must suffice to point out these as inferences which may be fairly drawn from the statistics now presented.

It must be evident, that the only proof of inflammation affecting the valves, fairly admissible in such an inquiry as the present, is that which is derived from recent fibrinous deposit found after death; but it is quite possible that, in an inferior degree, that thickening which is invariably found when inflammatory action is present, may of itself be the only effect produced. This conclusion would seem to be almost necessary, from the rarity of instances of fibrinous deposit after 35 years of age. All the conditions being found which we recognise as causes of endocardial inflammation, simple thickening or opacity of the valve may be the only form of lesion, and one is led to inquire, whether this may not be the result of recent inflammation in a minor degree. Again, the rarity with which fibrinous deposit has been traced to granular degeneration of the kidneys, out of the large number of cases in which these organs and the heart are simultaneously affected, would seem to point to the same possibility. And I am inclined to associate with these facts, an observation which I have occasionally made, of a state of excessive vascularity, or congestion, of the valvular

apparatus, which still was not such as to justify its being regarded as a condition of disease.

Having now examined all the cases of recent endocarditis, in the order in which they have been arranged, empirically, so to speak, in the Table, I may venture to arrange them according to the supposed cause of the development of the disease, along with any important complications.

6 are due to inflammatory disease—

- 1 to recent rheumatic fever,
- 1 to severe pneumonia, with previous rheumatic fever,

} complicated with pericarditis, pleurisy, and pneumonia.

- 1 to diffuse cellular inflammation of mediastinum, with previous rheumatic fever, and "large and mottled" kidney.
- 1 to pleuro-pneumonia, with pericarditis, and large and mottled kidney.
- 1 to inflammation of brain and lungs.
- 1 to diffuse cellular inflammation, with purulent pericarditis, and deficiency of one semilunar valve.

5 are due to previous valvular lesion, without dropsy—

- 1 to deficiency of one semilunar valve, with purulent pericarditis.
- 2 to thickening, and atheromatous disease, one complicated with pleurisy.
- 1 to previous rheumatic thickening, with pericarditis.
- 1 to rheumatic thickening, and calcareous deposit, with pericarditis (apparently due, in some measure, to jaundice).

3 are due to valvular lesion, with dropsy—

- 2 to rheumatic thickening, both complicated with pleurisy, and one also with pericarditis.
- 1 to rheumatic thickening, and atheromatous disease.

In 2 there was valvular lesion, with albuminuria and dropsy—

- 1 due to rheumatic thickening, and granular kidney.
- 1 to granular kidney, and atheromatous disease.

In 1 there were valvular lesion and hæmaturia—

Due to calcareous deposit, and large and mottled kidney.

In 2 there was albuminuria without dropsy—

Both due to atrophied kidney, one complicated with pericarditis.

In 1 there was albuminuria, with dropsy—

Due to atrophied kidney, complicated with previous thickening, and pleurisy.

The cases of *disease of longer standing* do not offer any points of interest when viewed in connection, except it be the way in which one form of disease may be superadded upon another in the same valve. This was before alluded to, in regard to those cases in which calcareous and fibrinous deposit were found together, when it was shown that the atheroma might be the cause of the endocarditis. But another condition would seem to be indicated, one in which a valve, having previously undergone an attack of acute inflammation, becomes afterwards the seat of atheromatous disease. Perhaps the safest evidence of this condition is derived from cases due to an old attack of rheumatic fever, the effect of which we know to be, in the first instance, to produce inflammatory thickening alone. Here the subsequent deposition of calcareous matter would seem to be a mere coincidence, from the fact, that the proportion of cases of a rheumatic origin, which exhibit traces of atheroma, is only very slightly greater than that derived from all diseased hearts together; and this excess probably arises from the circumstance, attendant on inflammatory action in all parts of the body, that it frequently serves as a predisposing cause for the development of special maladies, of which tubercles and cancer may be cited as examples. The difference may be represented thus:—

| | | |
|---|---|---|
| All the cases of diseased heart give a proportion of | 45 per cent. | of atheroma in general. |
| | 25 „ | of atheroma of the valves. |
| Diseased hearts connected with rheumatic fever give a proportion of | 53 „ | of atheromatous disease in general. |
| | 27 „ | of atheroma of the valves. |

These facts, in regard to cases of a rheumatic origin, prepare us for admitting, that the instances in which a greatly indurated condition of valve is associated with a slight deposit of atheromatous or calcareous matter, have been originally examples of inflammation of the endocardium, followed, after partial recovery, by the development of the specific malady.

Such cases occur pretty frequently among the instances of atrophied kidney.

In seventeen cases, *disease of the liver* is recorded as having been present, for the most part, in the contracted and granular form. This I was led to note, from the apparent connection in the case already detailed, between the supervention of jaundice and the excitement of renewed endocarditis, but I have not been able to draw any inference of value from these cases. Thickening of the tricuspid is mentioned eight times, but without its throwing any light on the subject of affections of the right side of the heart. Their comparative rarity is well known, as well as their constant connection with obstructions of the orifices on the other side.

In conclusion, I would merely remark, that while I conceive the chief value of these facts to consist in their being "contributions to the statistics" of valvular disease, I cannot but think some of the deductions worthy of attention, and demanding, at least, further investigation. The liability to double valvular disease, in consequence of rheumatic endocarditis; and the early incursion, as well as the commonly early termination, of that disease; the limit put by age, in so marked a manner, to fibrinous deposit on the valves of the heart; the very large proportion, amounting to almost one-half, of the fatal cases of granular kidney, found coincident with valvular disease, and its comparative rarity in those cases in which the kidney is large and mottled,—are all facts clearly proved by reference to the Table, in regard to the cases which have formed the ground of this analysis. To others I must leave to determine, whether the double valvular affection be the immediate, or the remote, consequence of rheumatic endocarditis, and whence the predisposition to renewed attacks of this disease is derived; whether endocarditis be ever due to a large and mottled condition of kidney, as its sole cause, and why, among so large a number of cases connected with Bright's disease, the inflammatory action was not more often found recent. One commonly-received opinion these statistics contradict, viz. that atheromatous disease affects,

by preference, the mitral valve; and another they render at least doubtful, viz. that it is in the advanced stage of Bright's disease endocarditis is liable to occur, unless, indeed, we are to admit the existence of endocardial inflammation without fibrinous deposit, or exudation.

*Table of Seventy-nine Cases*

| No. | Condition of valves. | | Age. | Sex. | Atheroma of aorta, when present. | Previous existence of acute rheumatism. | Abnormal state of heart. |
|---|---|---|---|---|---|---|---|
| | Aortic. | Mitral. | | | | | |
| 1 | Fibrinous deposit | fibrinous deposit | 12 | M | atheroma | none(?) | dilated |
| 2 | Thickened—fibrinous deposit | thickened | 12 | M | —— | old rheumatic fever | dilated—hypertrophied |
| 3 | Fibrinous fringes—only two valves | ——— | 14 | M | —— | none? | ——— |
| 4 | Thickened | thickened | 16 | M | —— | old and recent rheumaticfever | greatly dilated |
| 5 | Slight fibrinous deposit | opaque — extensive fibrinous deposit | 17 | M | —— | recent rheumatic fever | ——— |
| 6 | Small fibrinous fringes | thickened—contracted—calcareous fibrinous deposit | 18 | F | —— | old rheumatic fever | large—dilated |
| 7 | Much thickened—atheromatous—ulcerated | fibrinous deposit | 19 | M | —— | none | much dilated—slight hypertrophy |
| 8 | Thickened—rigid | calcareous deposit—fibrinous granulations | 22 | M | —— | old rheumatic fever | dilated—hypertrophied |
| 9 | Opaque—fibrinousfringes | thickened — opaque—rough—fibrinous deposit | 23 | M | —— | old rheumatic fever | greatly dilated hypertrophied |
| 10 | Opaque—thickened | much thickened—fibrinous deposit | 23 | F | —— | none | hypertrophied |
| 11 | Slight fibrinous deposit—granulated | fibrinous deposit | 24 | M | —— | old rheumatic fever | atrophied |
| 12 | ——— | fibrinous deposit—thickened | 28 | F | atheroma | none | hypertrophied |
| 13 | ——— | calcareous and fibrinous deposit—ulcerated | 28 | F | —— | none | ——— |
| 14 | ——— | thickened | 29 | F | —— | old and recent (?) rheumatic fever | ——— |
| 15 | Slight thickening | thickened fibrinous deposit | 30 | F | —— | old rheumatic fever | dilated — atrophied |
| 16 | Opaque—atheromatous—fibrinous edges | opaque thickened—calcareous deposit—fibrinous edges—ulcerated | 30 | M | atheroma | none | large—hypertrophied — great dilatation |
| 17 | Slight thickening | great thickening—fibrinous deposit | 31 | M | atheroma | old rheumatic fever | dilated—hypertrophied |
| 18 | ——— | much thickened—calcareous and fibrinous deposit | 34 | M | atheroma | none (?) | much dilated—atrophied |
| 19 | Slight thickening | ——— | 35 | M | —— | —— | dilated—fatty |
| 20 | Calcareous deposit—only two valves | ——— | 36 | M | —— | —— | dilated — atrophied |
| 21 | Thickened | much thickened | 36 | F | —— | none | dilated |
| 22 | ——— | atheromatous | 36 | M | atheroma | —— | hypertrophied |
| 23 | Slight thickening | ——— | 37 | F | —— | —— | ——— |
| 24 | Thickened—atheromatous—ulcerated | thickened—contracted | 37 | F | atheroma | old rheumatic fever | large and hypertrophied |
| 25 | Thickened | ——— | 37 | M | atheroma | —— | ——— |
| 26 | Opaque | slight thickening | 37 | M | atheroma | old rheumatic fever | hypertrophied |

*of Valvular Disease of the Heart.*

| State of pleura and pericardium. | | Diseased condition of kidneys. | Other lesions. | Chief cause of death. | No. |
|---|---|---|---|---|---|
| Recent inflammations. | Old adhesions. | | | | |
| ——— | ——— | ——— | pneumonia (tubercles) — brain congested—softened | inflammation of brain and lungs | 1 |
| pleurisy | pericardial | ——— | fibrinous deposit on endocardial membrane—pulmonary apoplexy | morb. cordis—dropsy | 2 |
| purulent pericarditis | ——— | ——— | pneumonia—secondary abscesses in lungs—admitted under surgeon with cellular inflammation | morb. cordis—diffuse suppuration | 3 |
| pericarditis | ——— | ——— | ——— | morb. cordis (sudden death) | 4 |
| pericarditis—slight pleurisy—(pneumonia) | ——— | ——— | lungs congested | pericarditis | 5 |
| pericarditis | ——— | yellow patch on one kidney | liver diseased (obliteration of secreting apparatus) — kidney slight similar affection—patch of discoloration of some depth | morb. cordis—jaundice—erysipelas | 6 |
| ——— | ——— | ——— | congestive pneumonia | morb. cordis | 7 |
| ——— | ——— | ——— | fibrinous deposit on endocardial membrane—pneumonia | morb. cordis—dropsy | 8 |
| pericarditis | pericardial | ——— | pulmonary apoplexy | morb. cordis—congestion of lungs | 9 |
| pleurisy | pleuritic | granular | excessive congestion of lungs—tricuspid thick | albuminuria—dropsy | 10 |
| pericarditis—puriform pleurisy—(pneumonia) | ——— | ——— | disintegrating pneumonia—vomica of lower lobes | inflammation of lungs | 11 |
| pericarditis | ——— | mottled—small—cortical substance wasted | tubercles in lungs—tricuspid thickened | morb. cordis—albuminuria | 12 |
| ——— | pericardial and pleuritic | mottled—large | pneumonia—diseased brain | bloody urine—softening of brain | 13 |
| pericarditis—pleurisy | pleuritic | ——— | pus in synovial capsules | sloughing—diseased joints | 14 |
| pericarditis—pleurisy | ——— | ——— | fibrinous deposit on endocardial membrane—pulmonary apoplexy | morb. cordis—dropsy | 15 |
| pleurisy | pleuritic | ——— | lungs congested | dropsy—morb. cordis—pleurisy | 16 |
| ——— | pericardial and pleuritic | granular—mottled—small | fibrinous deposit on endocardial membrane—excessive congestion of lungs | morb. cordis—albuminuria—dropsy | 17 |
| ——— | pleuritic | ——— | ——— | morb. cordis—dilatation | 18 |
| ——— | pleuritic | ——— | brain congested—softened—tubercles of lungs | affection of brain | 19 |
| ——— | ——— | ——— | brain congested—congestive pneumonia | delirium tremens | 20 |
| ——— | ——— | slightly granular—cysted | lungs congested—liver contracted | morb. cordis—congestion of lungs | 21 |
| puriform pleurisy—(peritonitis) | ——— | mottled—large | diffuse cellular suppuration from wound | suppuration—secondary inflammation | 22 |
| ——— | pleuritic | granular | ——— | gangrene | 23 |
| ——— | ——— | ——— | pneumonia—tricuspid thickened | morb. cordis—albuminuria—dropsy | 24 |
| ——— | ——— | ——— | previous cellular inflammation with condensation in thigh—diseased elbow-joint—no history | suppuration (sinking) | 25 |
| ——— | pericardial and pleuritic | very granular—mottled—small—cysted | peritonitis | morb. cordis—albuminuria—dropsy | 26 |

*Table*

| No. | Condition of valves. | | Age. | Sex. | Atheroma of aorta, when present. | Previous existence of acute rheumatism. | Abnormal state of heart. |
|---|---|---|---|---|---|---|---|
| | Aortic. | Mitral. | | | | | |
| 27 | Thickened | ——— | 39 | M | atheroma | old rheumatic fever | flabby |
| 28 | Thickened—fibrinous deposits—only two valve | ——— | 39 | M | atheroma | none | dilated—slight hypertrophy |
| 29 | Slight fibrinous deposits | ——— | 40 | F | atheroma | —— | ——— |
| 30 | Slightly opaque | ——— | 40 | M | —— | none (?) | large—soft |
| 31 | ——— | thickened | 41 | F | —— | none | fatty—hypertrophied |
| 32 | Greatly thickened—contracted | ——— | 42 | M | —— | —— | slight hypertrophy |
| 33 | ——— | greatly thickened—cartilaginous | 43 | F | —— | none | great hypertrophy |
| 34 | Thickened — atheromatous | ——— | 43 | M | atheroma | none | large — greatly dilated—slight hypertrophy |
| 35 | Much thickened—contracted | ——— | 44 | M | —— | —— | large—greatly dilated—flabby —fatty |
| 36 | ——— | atheromatous deposit | 45 | F | —— | none | fatty—large |
| 37 | Slightly thickened | atheromatous | 45 | F | —— | old rheumatic fever | large—hypertrophied — slight dilatation |
| 38 | Thickened—ulcerated—only two valves | ——— | — | M | atheroma | none | greatly dilated —hypertrophied |
| 39 | ——— | cartilaginous—ulcerated —calcareous deposit | — | F | —— | none | slight hypertrophy |
| 40 | Opaque | thickened | 45 | F | —— | none | dilated —slight hypertrophy |
| 41 | Abundant fibrinous granulations | slight fibrinous deposit | 45 | F | —— | —— | slight hypertrophy |
| 42 | Slight thickening | ——— | 46 | M | —— | —— | ——— |
| 43 | Slightly thickened | slight thickening | 46 | M | —— | none (?) | dilated—hypertrophied |
| 44 | ——— | slight thickening | 46 | F | —— | none | small — right hypertrophy |
| 45 | ——— | thickened | 46 | F | —— | —— | small |
| 46 | Slight thickening | slightly thickened | 47 | M | atheroma | none (?) | hypertrophied |
| 47 | Slightly atheromatous | ——— | 48 | M | —— | none (?) | dilated |
| 48 | Opaque | slightly thickened | 48 | F | —— | none | small—thin |
| 49 | Thickened | ——— | 50 | M | —— | —— | ——— |
| 50 | Thickened—atheromatous and fibrinous deposits | slight thickening | 50 | F | —— | none | dilated — reat hypertrophy |
| 51 | Slightly atheromatous | slightly atheromatous | 51 | M | atheroma | —— | dilated—flaccid |
| 52 | Opaque—contracted | ——— | 51 | F | atheroma | none | flabby |
| 53 | Slight thickening | ——— | 53 | M | atheroma | —— | hypertrophied |
| 54 | Slightly atheromatous | slightly atheromatous | 54 | F | atheroma | none (?) | dilated—hypertrophied |
| 55 | Abundant fibrinous deposit | fibrinous deposits | 55 | M | atheroma | old rhematic fever | slight dilatation and hypertrophy |
| 56 | Atheromatous—ossified | atheromatous—ossified | 55 | M | atheroma | none | dilated |
| 57 | Opaque—atheromatous | thickened | 55 | M | —— | —— | large—fatty |
| 58 | ——— | slight thickening | — | M | atheroma | —— | great hypertrophy |
| 59 | ——— | thickened | 55 | M | —— | none | hypertrophied |

*continued.*

| State of pleura and pericardium. | | Diseased condition of kidneys. | Other lesions. | Chief cause of death. | No. |
|---|---|---|---|---|---|
| Recent inflammations. | Old adhesions. | | | | |
| pleurisy | pericardial and pleuritic | ——— | aorta wide | morb. cordis—dropsy | 27 |
| puriform pericarditis | ——— | congested | lungs congested — pulmonary apoplexy | morb. cordis — congestion of lungs | 28 |
| ——— | pleuritic | granular | brain anæmic — sub-arachnoid fluid in small quantity | albuminuria—paralysis —vomiting | 29 |
| pericarditis — pleurisy — (pneumonia) | ——— | large—coarse | liver enlarged | pleuro-pneumonia | 30 |
| ——— | pleuritic | granular—mottled—small | ——— | erysipelas | 31 |
| ——— | ——— | ——— | tubercles of lungs | phthisis | 32 |
| ——— | ——— | very granular—cysted | tricuspid—thickened | morb. cordis—albuminuria—dropsy | 33 |
| puriform pericarditis | ——— | ——— | fibrinous deposit on aorta—cirrhosis of liver | morb. cordis—dropsy | 34 |
| ——— | ——— | ——— | ulcer of leg of thirty years standing from injury — diseased bone—amputation | sloughing stump | 35 |
| slight pericarditis | pericardial | granular | liver contracted—granular | dropsy | 36 |
| pleurisy | ——— | granular | rheumatic fever sixteen years ago | morb. cordis—albuminuria—dropsy | 37 |
| ——— | ——— | ——— | pulmonary apoplexy | morb. cordis—dropsy | 38 |
| pleurisy (pneumonia) | pleuritic | small — very granular | ——— | dropsy | 39 |
| ——— | ——— | ——— | liver large—irregular | morb. cordis—dropsy—ascites | 40 |
| pericarditis — pleurisy — (pneumonia) | pericardial | mottled—large | grey hepatization of lung | pleuro-pneumonia | 41 |
| pleurisy | ——— | ——— | congestive pneumonia — encephaloid disease of abdomen | disease of abdomen | 42 |
| ——— | pleuritic | ——— | liver granular—tricuspid thick | morb. cordis — slight dropsy | 43 |
| ——— | pleuritic | granular—small | tricuspid fatty | morb. cordis—albuminuria | 44 |
| ——— | pleuritic | ——— | liver contracted | dropsy—jaundice | 45 |
| ——— | pleuritic | granular | thickening of peritoneal membrane | dropsy | 46 |
| ——— | pleuritic | coarse | fibrinous deposit on aorta—diseased joints — congestion of lungs — supposed rheumatic gout | diffuse cellular inflammation | 47 |
| ——— | pleuritic | granular—small | tricuspid thick | morb. cordis—dropsy | 48 |
| ——— | pleuritic | granular | ——— | sinuses—debility | 49 |
| ——— | ——— | granular | ——— | album nuria—dropsy | 50 |
| ——— | ——— | ——— | brain wet — lungs congested—liver fatty | delirium tremens | 51 |
| ——— | pleuritic | fatty — large—cysted—coarse | cirrhosis of liver—peritonitis | ascites—albuminuria | 52 |
| puriform pleurisy | ——— | granular | brain congested and wet—lungs much congested | scalp-wound | 53 |
| ——— | pleuritic | ——— | brain congested—softened—inflammation of liver | affection of brain | 54 |
| ——— | pericardial and pleuritic | mottled—large | pneumonia—cellular inflammation of neck and mediastinum —congestion of liver | morb. cordis—pneumonia — diffuse cellular inflammation | 55 |
| ——— | ——— | congested | lungs congested — pulmonary apoplexy—cirrhosis of liver | morb. cordis. — dropsy | 56 |
| pleurisy | ——— | very granular—mottled—small | ulceration of aorta | empyema—fits | 57 |
| ——— | ——— | small — very granular | apoplectic clot in brain | apoplexy | 58 |
| pleurisy—(pneumonia) | ——— | ——— | diseased liver | dropsy—pneumonia | 59 |

*Table*

| No. | Condition of valves. | | Age. | Sex. | Atheroma of aorta, when present. | Previous existence of acute rheumatism | Abnormal state of heart. |
|---|---|---|---|---|---|---|---|
| | Aortic. | Mitral. | | | | | |
| 60 | Opaque | —— | 55 | F | atheroma | —— | slight dilatation |
| 61 | Slightly thickened | —— | 56 | M | atheroma | none (?) | dilated—hypertrophied |
| 62 | —— | thickened | 56 | F | —— | none | large — flabby — greatly dilated |
| 63 | Slightly thickened | —— | 57 | M | atheroma | —— | flaccid—soft—thin |
| 64 | Slight thickening | —— | 58 | M | atheroma | —— | hypertrophied—soft |
| 65 | Atheromatous | opaque | 59 | M | atheroma | none (?) | very large—dilated—hypertrophied |
| 66 | Rough — thickened—ulcerated | slightly thickened | 60 | M | atheroma | none (?) | great hypertrophy |
| 67 | —— | thickened — cartilaginous—atheromatous—ulcerated | 60 | F | —— | none (?) | greatly dilated |
| 68 | —— | thickened — slightly atheromatous | 60 | F | atheroma | none | large — hypertrophied |
| 69 | Thickened atheromatous deposit | thickened | 63 | F | —— | none | large—fatty |
| 70 | Thickened calcareous deposit | thickened | 65 | F | atheroma | none (?) | contracted—hypertrophied |
| 71 | Atheromatous—ossified | thickened | 66 | M | atheroma | | —— |
| 72 | Opaque | slightly thickened | 67 | F | atheroma | —— | slight hypertrophy |
| 73 | Thickened | —— | 70 | M | atheroma | none | hypertrophied |
| 74 | Atheromatous | —— | 70 | F | atheroma | —— | —— |
| 75 | —— | atheromatous | 70 | M | atheroma | —— | slight dilatation and hypertrophy |
| 76 | —— | calcareous deposit | 74 | F | —— | —— | large—fatty |
| 77 | Slightly thickened | slight thickening | 75 | M | atheroma | —— | dilated—hypertrophied |
| 78 | Thickened—opaque | —— | 79 | M | atheroma | —— | hypertrophied |
| 79 | Atheromatous | —— | — | F | atheroma | —— | slight hypertrophy |

*continued.*

| State of pleura and pericardium. | | Diseased condition of kidneys. | Other lesions. | Chief cause of death. | No. |
|---|---|---|---|---|---|
| Recent inflammations. | Old adhesions. | | | | |
| ——— | pleuritic | ——— | slight pneumonia — purulent bronchitis — liver congested (gorged) | purulent bronchitis | 60 |
| pleurisy—(pneumonia) | ——— | small—granular | aorta dilated—ulceration of duodenum—peritonitis | morb. cordis—albuminuria—dropsy—peritonitis | 61 |
| pericarditis — pleurisy — (pneumonia) | ——— | granular | liver contracted—granular | morb. cordis — pleuro-pneumonia | 62 |
| ——— | ——— | ——— | pneumonia (tubercles)—old peritoneal adhesions—old ulcer of leg | pneumonia (sinking) | 63 |
| ——— | pleuritic | ——— | congestive pneumonia | mortification of foot | 64 |
| ——— | pleuritic | small—granular | aorta greatly dilated—ulcerated | morb. cordis — albuminuria—dropsy | 65 |
| ——— | ——— | mottled—large | continued fever with cardiac murmur twelve months previously — tricuspid thickened—gout (?) | morb. cordis — albuminuria | 66 |
| ——— | ——— | granular—small | liver granular | morb. cordis—albuminuria—dropsy | 67 |
| ——— | ——— | congested | ——— | morb. cordis—dropsy | 68 |
| ——— | pleuritic | very granular—cysted | liver contracted | morb. cordis—albuminuria—dropsy | 69 |
| ——— | pleuritic | granular | brain congested—diseased arteries | congestion of brain | 70 |
| ——— | pleuritic | small—granular | thickening of sub-peritoneal tissue — peritonitis — tricuspid thick | dropsy—ascites | 71 |
| ——— | pleuritic | granular—wasted | ——— | incessant vomiting — albuminuria | 72 |
| ——— | pleuritic | ——— | ——— | general debility | 73 |
| ——— | ——— | ——— | ossification of arteries | gangrene senilis | 74 |
| ——— | ——— | ——— | coronary arteries calcareous | fit—(collapse) | 75 |
| ——— | pleuritic | granular—mottled—small | ——— | strangulated hernia | 76 |
| ——— | pleuritic | ——— | cretaceous matter in lungs | fracture of femur | 77 |
| ——— | pleuritic | ——— | aorta dilated—ulcerated | fractured ribs | 78 |
| pleuro-pneumonia | ——— | ——— | diseased coronary arteries | gangrene senilis | 79 |

ON THE

# ANATOMY AND PHYSIOLOGY

OF THE

# CYSTICERCUS TENUICOLLIS.

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In the year 1833, I contributed a paper on the Vesicular Entozoa,* to the London Medical Gazette, in which, I fear, I did little more than repeat the errors of my predecessors; still, in that imperfect summary, I *did* call the attention of zootomists to the existence of an organ, hitherto unobserved, which I had discovered in my examinations of the Cysticercus tenuicollis, and which is readily observed *within* the caudal vesicle, suspended from that portion where what has been called the body of the entozoon terminates and the vesicle commences. I long hoped that the above notice would have caught the eye of some comparative anatomist possessing more facilities for the investigation than myself, and have incited him to undertake a more elaborate dissection of the entozoon; but my anticipations not having been realized, I again took up the subject, and the result of my researches I have now the honour of laying before the Fellows of this Society.

Previously to entering upon the history of my own inquiries and dissections, I will briefly trace chronologically the steps of preceding naturalists in the examination of this genus of the entozoa Cystica.

As early as the year 1654, Bartholin cursorily described

* London Medical Gazette, 1833, vol. xiii. p. 205.

Hydatids (believed by Rudolphi to be Cysticerci), which he considered to be animated, but did not esteem them to be worms.*

About the same period, Steno discovered bladders (Cysticercus tenuicollis) in the omentum of a rein-deer, which he described as if pregnant, or containing one within another.† It is most probable that Steno mistook the omental cyst for the parent hydatid, and the true parasite for the offspring; the *cyst* being commonly so transparent, as to give it very much the appearance of a bladder of water, suspended by a pedicle.

Hartmann, in the year 1685, was the first to pronounce this hydatid to possess *independent* vitality, he having placed one (which he had taken from the omentum of a goat) in warm water, and observed its undulatory movements.‡ He also noticed the retracted neck and head.

Our countryman, Tyson, in 1691, made discoveries to the same extent, without being aware of what Hartmann had published. Tyson considered the caudal vesicle to be the stomach of the worm. His paper (published in the Philosophical Transactions) is entitled, "Lumbricus hydropicus; or, an Essay to prove that Hydatides, often met with in morbid animal bodies, are a species of Worms, or Imperfect Animals."§

Pallas, who wrote in 1766, was the first to enter elaborately into the natural history of vesicular worms: having minutely examined this hydatid, and imagined that its mouth resembled that of the Tæniæ, he named it Tænia hydatigena.‖

Goeze, Zeder, Steinbuck, and Rudolphi, did but perpetuate the errors of their predecessors, contributing nothing to the knowledge previously acquired respecting their anatomy and generation. The recent writers on the same subject, of this country, Houston, Knox, Owen, Gulliver, and Goodsir, have

* Entozoorum, sive Verm. Intest. Hist. Nat., vol. i. p. 119.
† Idem, loc. cit. ‡ Idem, p. 112.
§ Opus cit., vol. i. p. 112.
‖ Elench. Zooph., p. 413; also Spicileg. Zoolog., Fasc. 12, p. 42.

made us much better acquainted with the anatomy of this entozoon; to whose contributions I shall have occason to refer, *en passant*.

Till the period of Harry Goodsir's researches, the Cysticercus had been described as made up of a head armed with a double row of hooklets, and furnished with four mouths or suctorial cups, a neck, body, and caudal vesicle; and various had been the offices assigned to these components of the parasite. Of the parts connected with the imaginary head, some authors have considered the hooklets to be for the purpose of attachment to the containing cyst, and the whole *body*, therefore, an organ of prehension; others have looked upon them as teeth; and a third party thought them subservient to the generative process. With regard to the four oscula, Steinbuck, finding that they were not patent, and consequently could not be mouths, conceived the preposterous notion (as late as 1802), that they performed a respiratory function. Rudolphi and several earlier naturalists described them as true mouths, for the purpose of sucking in nutriment, each mouth opening into a canal, which either passed separately towards the caudal vesicle, or, uniting into one common canal, terminated in the caudal vesicle. Some recent writers have given credence to the above statements of Rudolphi, and also reiterated them; but whoever reads his remarks upon this portion of the subject will be quite satisfied that he had promulgated conjectures rather than observations. The late Dr. Houston, of Dublin, in reference to the so-called mouths, says, "These depressions are called mouths, meaning thereby patulous orifices, but from my own observations I believe them to be covered over by the same kind of transparent membrane as that which completes the anterior planes, for I had abundant opportunities of remarking that the fluid of the caudal vesicle when squeezed along the neck into the head, protruded and rendered them prominent, without making its escape from apertures in their centre."* The appearance of their being covered by a

* An account of Hydatids found in the omentum of an axis-deer. Dublin Journal of Science, &c., vol. viii. p. 271.

membrane, and made to protrude by propelling the fluid of the vesicle against them from behind, is fallacious. I have repeatedly produced a similar aspect with the compressing instrument (a paper knife), when effecting the extrusion of the retracted head. It is, in fact, an eversion of the suctorial cups; and with regard to the passage of the fluid along the body, the Doctor was likewise deceived; for the fluid cannot be forced along the body, without first rupturing the lining membrane of the vesicle, as I shall show hereafter.

Dr. Roget also imbibed the erroneous idea of four mouths communicating with the caudal vesicle, which he pronounced a stomach:* but it is manifest that he did not investigate the point himself.

Even Professor Owen has in part adopted the errors of the early naturalists, as he states that, "In the larger Cysticerci, lateral canals may be traced from the suctorious pores extending down the body towards the terminal cyst, but they appear not to terminate in that cavity, the fluid of which is more probably the result of secretion or endosmosis."†

After this brief summary of the labours and opinions of those who have preceded me in this field of inquiry, I proceed now to lay before you the result of my own investigations and dissections.

The Cysticercus tenuicollis infests chiefly Ruminants, is continually met with in sheep, and occasionally in the hog; its proper *habitat* is the peritoneum, or the pleura, but it is very much more frequently seen in the former than in the latter; a serous membrane appears to afford its proper nidus, as it never invades the parenchyma of a viscus, but is entirely confined to the peritoneal or pleural covering. It is invariably found in a cyst, and in the abdomen is met with enveloped, either in the omentum, or hanging from various parts within the peritoneal bag. The formation of the cyst, and the morbid changes which it frequently undergoes, I

* Bridgewater Treatise, by Dr. Roget, vol. ii. pp. 84, 113.

† Dr. Todd's Cyclopædia of Anatomy and Physiology, vol. ii., article Entozoa, p. 131.

shall only briefly notice hereafter; but, on those matters, I would more particularly direct attention to an elaborate paper by the late Dr. Houston,* before referred to, and in which will be found a full and accurate description of this envelope, in its normal and also in its anormal states.

The entozoon itself is a vesicular body, constructed of translucent membranes, containing a limpid fluid, and from its anterior part is produced an elongated cylindrical structure, hitherto considered the true body, or vermiculum, but which, from analogies afterwards to be offered, I am disposed to call a *proboscis*.†

This hydatid acquires a magnitude sufficient to weigh twenty-five drachms, and to possess fluid contents amounting to three ounces by measure. I have repeatedly met with them of this bulk; to what extent they may continue to grow I have not determined: the above sized specimens were taken from a one-and-a-half year old sheep—a *sheerling*—and as their *habitat* offers no physical impediment to their progressive increase, we may fairly infer that an extension of life to the animal would be productive of a further growth of the parasite; doubtless, also, their magnitude is a measure of their age. It is almost unnecessary to remark that, where a colony of these hydatids is established, they occur of various sizes; I have had twenty-two specimens sent me from the same abdomen, varying from the size of a nutmeg to that of a goose's egg. The large hydatids do not appear to distend their cysts at all more than the smaller ones, the cyst unquestionably growing with its inhabitant.

A glutinous fluid is invariably found within the cyst, occupying the small space between it and the hydatid; with the aid of a microscope it is discovered to consist of a large

* Opus cit., p. 277, et seq.

† It appears that Mr. Harry Goodsir is the first who has taken a more correct view of the conformation of this entozoon; he considering the caudal vesicle to be its proper body, and the hitherto-called body but a pedicle. *Vide* Anatomical and Pathological Observations, No. XIII. p. 91.

proportion of oil globules, with a few globules of *pus*, mechanically incorporated with serum (?) : it contains a large quantity of albumen.

When the hydatid is first removed from the cyst, particularly if through a large opening, its form is nearly spherical; and it exhibits at the anterior part of its long axis an oval, labiated, opaque protuberance—the retracted proboscis.

Everting the proboscis elongates the vesicle, and the hydatid becomes pyriform. When thus unfolded, the proboscis exhibits coarse transverse plicæ, and the vesicular body a delicately plicated surface, similarly arranged. The evertion is not a difficult manipulation,* if attempted upon a recent specimen; but after some decomposition has taken place, it cannot be so readily effected, by reason of its delicate texture easily giving way.

*Structure of the vesicle.*—The vesicular *body* is constructed of two laminæ, or coats; the external or fibrous, and the internal or granular: its form is spheroidal, but with its proboscis protruding it is pyriform, and it is replete with a transparent fluid, to the amount of three fluid ounces in large specimens.

The *external coat* is made up of three sets of fibres; two of the three decussate each other at right angles, forming a network of longitudinal and transverse fibres; the third set are seen to run in all directions, although those passing transversely are most distinct, and under a power of one-eighth, greatly resemble the fibres of the middle coat of an artery, as figured by Müller, Plate II. fig. 6; they undoubtedly form an elastic tissue, a kind of structure which alone accounts for the remarkable degree of elasticity possessed by the entozoon.

The Cysticerci exhibit muscular motion, and it is asserted that they protrude their retracted proboscis during the undu-

* I have found no difficulty in unfolding the retracted part, by pressing it gently with the fore-finger of my left hand, at the same time assisting its evertion with a paper-knife, used in a pressing and rather scraping manner.

latory movements excited by immersion in warm water; the latter circumstance I have never witnessed, although I have frequently immersed them, and watched their proceedings. There has not yet been detected in their structure, either the fibre of voluntary or of involuntary muscle; still, as modern anatomists consider that an animal so low in the scale of organization requires a less complicated muscular texture, we may, perhaps, assume that the *decussating* fibres possess the requisite muscular function.* The *internal* coat is composed of a form of albuminous matter having a granular character: it has incorporated with it some carbonate of lime, and probably a larger portion of the phosphate; it has also a great abundance of oil-globules interspersed throughout; it possesses no fibrous texture, and when decomposition has, to a certain degree, advanced, it separates from the external coat, and falls to the bottom of the vesicle.† The internal coat, after having formed a lining to the fibrous lamina, is reflected over an organ (to be described hereafter) hanging from the proboscis into the fluid of the vesicle, and to which it forms a covering. In passing from the parietes of the vesicle on to the above-mentioned organ, it forms a septum (fig. 1, *h*) between the cavity of the vesicle and the interior of the proboscis, and therefore precludes the escape of the fluid of the vesicle in that direction, and, consequently, the distention or protrusion of the proboscis. The *fluid* of the vesicle has been analysed by Collard de Martigny, and others; the former found it to be composed of *water* 96·5, *albumen* 2·9, and salts, for the most part *chloride of sodium*, 0·6. By Göbel it is said to contain some phosphate of lime.‡

*The Proboscis.*—The external membrane of the vesicular *body* is produced anteriorly, to the extent of from a quarter

* Professor Owen says,—"Although in every order, both of the Parenchymatous and Cavitary worms, living specimens have been observed to exhibit sufficiently conspicuous motions, yet their muscular fibre is not always distinctly eliminated in them."

† The separation and deposit is well exhibited in preparation No. 224, of the entozoa Cystica, in the Museum of the Royal College of Surgeons.

‡ Simon's Chemistry (translation by Day), vol. ii. p. 484.

of an inch to nearly an inch in length, according to the age of the hydatid, and forms a tapering, cylindrical, transversely plicated appendage, terminated by a subtetragonal enlargement, armed with a double row of hooks, and having placed at each angle (?) a suctorial cup (fig. 1, *b*). The external tissue of this appendage is thickly beset with oval corpuscles, throughout its texture, from its commencement at the vesicle, to within a very short distance of its extremity; they are very closely arranged upon its surface, but evidently loosely attached, for a slight scraping readily detaches some of them.

The *corpuscles* have been described, and their size minutely determined, by Mr. Gulliver;* he has shown, also, that they contain a notable quantity of carbonate of lime in their composition; a circumstance which accounts for the opacity observed in the texture, of which they form so considerable a proportion. He thinks it probable that they are the ova of the Cysticercus; Klencke† also believes them to be ova; and Goodsir describes as ova, similar bodies found in the pedicles upon the vesicle of the Cænurus cerebralis.‡ Having been favoured with an opportunity of examining the oval corpuscles under one of our most powerful microscopes, and, at the same time, had the advantage of Mr. Busk's valuable assistance, I do not hesitate to pronounce (having his high authority for so doing) that they are not ova, but are, in reality, as far as structure goes, what Mr. Gulliver satisfactorily demonstrated them to be, "oval bodies possessing a granular texture, with a calcareous shell;" thus giving firmness to the structure—in short, forming a coat of mail to an organ whose duties, in all probability, required it. It will be seen, by the very accurate figures given in illustration of Mr. Gulliver's paper, that but few corpuscles are interspersed through the enlarged terminal portion of this organ, that part in which the suctorial cups

* Medico-Chirurg. Trans., vol. vi. 2nd series, p. 4.

† Professor Siebold's Report on Helminthology, translated by Busk for the Report on Zoology, Ray Society, 1847.

‡ Trans. of Royal Society of Edinburgh, vol. xv. 1844, p. 561.

and coronet are situated; which is undoubtedly a necessary provision, for, had it been otherwise, the flexibility required by the function of the suctorial cups could not have existed, and their presence, consequently, would have been rendered useless.

I have once met with a congeries of the oval corpuscles, congregated into a circular patch, upon the external membrane of the vesicle, and very remote from the proboscis; to the naked eye it appeared a small white speck, about half a line in diameter, but which, by the microscope, was resolved into an assemblage of corpuscles, as in fig. 2. The circumstance can, of course, be only viewed as one of the inscrutable freaks of nature, analogous to the occurrence of maculæ studded with hairs, upon the human integument.

*The hooks.*—The circlet of hooks attached to this organ is composed of thirty-two: they are alternately placed in and out, forming a double row; its form and arrangement are so accurately described by Mr. Gulliver, in the paper before referred to, that I have but few observations to make respecting it. At the point of junction of the curved spine with its clavated arm, or *manubrium*, is a process described by Mr. Gulliver as "a short blunt lateral branch, or process;" after repeated examinations, particularly when the hooks were thrown back, and the circle was fully expanded, I have determined that the process is not placed laterally, but anteriorly, in a line with the manubrium and apex of the hook. The hooks are alternately long and short, the difference depending chiefly on the length of the manubrium. The former are 1-125th of an inch in length; the latter, 1-250th. The process of the short hooks I have found to be *bifid* (fig. 3, *a*), while that upon the long ones is formed as Mr. Gulliver has described.

The form, structure and arrangement of the hooks lead me to infer that they are capable of free movement around the centre to which they are attached; and we cannot but suppose that there are special muscles for the designed actions of the hooks. Under this impression, I am induced to think that the processes are the points of insertion of those muscles, although my microscope has not at present laid

open any trace of such a structure. Muscular action must be required, either for the convergence or divergence of these instruments; and, supposing divergence, or their expanded form, to be the quiescent state of the circlet of hooks, convergence—a forward movement, a kind of flexion—would be its instinctive and active movement, effected by muscular action; then, admitting elasticity as the antagonistic force to the muscular (a property greatly prevailing in all parts of the hydatid), an antagonism effectively employed in the economy of testaceous mollusks, by it its expanded position would be recovered, and thus, with one muscle only to each, could the requisite alternate actions of the hooks be efficiently produced. The office of this interesting structure, this elegant coronet (for it is a very beautiful microscopic object), appears to be solely that of a mechanical irritant—an instrument wherewith to scratch the interior of the vascular cyst, for the purpose of exciting it to secrete a pabulum for the sustenance of its tenant,—an opinion I was led to adopt from having always observed, when examining the Cænurus cerebralis *in situ*, that that portion of the *cyst* immediately in contact with its proboscis was much more vascular than any other part of it.*

It has been observed by those authors who have met with this entozoon in a state which showed that it had died previously to the death of the infested animal, that it was invariably found with its proboscis completely unfolded, even to the entire exposure of its crown of hooks. It has always occurred to me to find it so likewise, and the circumstance may, in my opinion, be thus explained. There is every reason to believe that the proboscis is retracted by a muscular power, the energy of which will be in direct ratio with the vigour of the hydatid. The noxious food furnished by the morbid action going on in a diseased cyst necessarily debilitates and ultimately destroys the muscular power of the parasite; its instinctive struggle for food—"a stimulus of necessity"—keeps the organ protruded, and in which state it

* See Todd's Cyclopædia, vol. ii. p. 131.

remains at its death. Dr. Knox, in an interesting paper on the Cysticercus cellulosæ,* writes:—"Whilst examining these hooks or spines under powerful glasses, I remarked that they were arranged in a double row, and, at the base of each alternate one, so far as I could observe, there was a small rounded body, resembling an ovum or egg, and their appearance has suggested to me the idea, that these rounded bodies may be the young Cysticerci developed at the base of each hook;" but the Doctor also says, "I throw out this opinion merely as a conjecture." I have myself, aided by a most satisfactory display of the parts, repeatedly searched in vain for these "rounded bodies at the base of each alternate hook" in the Cysticercus tenuicollis; and as it is probable that they would be more readily recognised in this much larger individual, I do not hesitate to conclude that no such bodies exist, and that Dr. Knox in all probability merely saw one of the oval corpuscles, so thinly implanted hereabout, in the position he describes.

*The Suctorial Cups.*—The nature of these concavities has given rise to much discussion. Up to a very recent period they were considered by zootomists to be patulous mouths for the absorption of nutriment; but since it has been satisfactorily demonstrated that they afford no channel to the interior of the hydatid, a suctorial function has been appropriated to them.

The cups are circular, and, when examined under the microscope, with a power of one-eighth, exhibit a sharp outline; they are abrupt hollows, by which I mean, not shallow. Their interior is perfectly smooth, and there is no opening in their fundus. With the same magnifying power, concentric fibres are distinctly seen around their margins, and I believe that I have seen transverse fibres dipping towards the interior at right angles to the circular ones. In this instance, also, can it be doubted that these fibres possess the property of muscularity, although the microscope does not detect in them the characteristics of those of a muscle

* Lancet, vol. ii., 1837-38, page 397.

of either animal or organic life? Fig. 2 of Mr. Gulliver's plate* does not give a correct delineation of the *cups*, as seen in a recent specimen mechanically unfolded; they are made to appear *convex*, or protruding.

In the study of the physiology of this parasite, various offices have been assigned to the appendage now occupying our attention. From its early history, up to a recent period, it has been considered the head and body of the worm, absorbing nutriment by four mouths, and attaching itself to the cyst by its crown of hooks. Houston having assured himself that the so-called mouths were not patent, looked upon it as a rudimentary part—a type of transition to an animal of a higher grade. Gulliver leans to the idea that it took a share in the generative process, for he writes:—"It is an interesting question, whether the spherules of the caudal vesicle may not be considered as nuclei, which advance to the neck or body of the worm, and there become invested with cells, and so formed into the complete oval corpuscles."† And Goodsir, taking a somewhat similar view, observes:—"The *pedicles* of these two latter animals (Cænurus and Cysticercus) are analogous to the reproductive nucleus."‡ For my own part, I can see in it but the analogue of the anterior extremity of an Echinorhynchus, or of a Bortriocephalus, and therefore have denominated the entire pedicle the proboscis.

Thus far, our attention has been occupied with the anatomy of the external parts of the entozoon. We will now proceed to the internal. Upon opening, by a crucial incision, the vesicular *body* of the hydatid,§ and carrying the antero-

* Transactions of Royal Med.-Chir. Society, vol. vi., second series, plate 1.

† Transactions of Royal Med.-Chir. Society, vol. vi., new series, p. 8.

‡ Anatom. and Pathol. Observations, page 93.

§ The readiest mode of dissecting the vesicular entozoa is the following:—Procure a *wooden plate*, or trencher, and paint it black. Upon this fix your hydatid (after having everted its proboscis), by passing a pin through the anterior portion of the proboscis. Now fill the plate with cold water, when, upon opening the vesicle, as above directed, and pinning the anterior flaps back, you will have the pendulous organ distinctly exhibited, and in this way only can you readily examine it, and manipulate with facility.

posterior incision forwards quite up to the commencement of the proboscis (previously everted), the observer will notice upon turning aside the anterior flaps, a transparent gelatinous filament floating in the fluid of the vesicle, and pendulous from that part of the interior of the vesicle where the proboscis commences (fig. 1, *f*). On carefully laying open the dense texture of the proboscis, and turning it aside, he will find that he can trace this pendulous body passing forward for three-fourths of the length of the former. We may therefore describe it as arising high up within the proboscis, and passing along it till it enters the vesicle, where it hangs floating in the liquid contents. I am inclined to think that, within the proboscis, its form is that of a hollow cylinder,* to admit of the inversion of that body; but within the vesicle, although retaining the cylindrical form, it appears to be solid, and tapers to a blunt point (fig. 4, *f*). From this point, a single filament (fig. 4, *f*), or two, or more, or sometimes a tuft (fig. 4, *g*) of slender filaments, is suspended, which filaments either float in the fluid, or are loosely attached to the parietes of the vesicle by still more slender filaments. These filaments may be detected by pulling the pendulous body with forceps, when a dragging of the parietes will be observed at the point of their attachment. The tissue of this pendulous body, arising from the interior of the proboscis, is very intimately connected with the tissue of the latter, particularly where it terminates in the vesicle; for it is impossible to separate one from the other without bringing, with the former, portions of the inner layer of the latter, having an abundance of oval corpuscles attached.

This pendulous organ is not always met with as a single body, but is more frequently than not accompanied with one, two, and even three off-sets: in fig. 5 it will be observed there are three, the principal organ hanging loose, and much

* I have passed a fine bristle into it, after the anterior fourth part of the proboscis has been cut off; but its texture is so delicate that it may have pierced its substance, and not entered a tube. In fig. 4, a bristle is exhibited, passing between it and the surrounding tissue.

longer than the others, an adjoining off-set recurved with its extremity adhering, a second off-set enveloped in the inner coat of the vesicle, and the third very short, and slightly projecting. It is not an unfrequent circumstance to meet with the principal organ, and also its off-sets, entirely embedded in the inner coat of the vesicle. The length of this organ is chiefly determined by the growth or age of the hydatid, but not invariably so; for although in a large hydatid you will never meet with a short pendulous body, still in a small hydatid you occasionally find a disproportionately long one, particularly if you include the slender filaments, or tuft of them.

The texture of this organ is only to be ascertained with the microscope; every part of it is very strong, and remarkably elastic, even to the finest filaments. It is composed of cellular tissue; of elastic tissue resembling that of the parietes of the vesicle, but of a more delicate texture; and also of a tissue, which, with a power of 200 diameters, appears in the form of longitudinal fibres, passing in parallelism. In dilatations of the organ which are not unfrequently seen, the fibres are observed to form volutions.

These fibres are moreover continued into the slender portions of this pendulous body and tufts. With the aid of the microscope, there are also observed in this organ deposits of granular matter and minute oil-globules, both of which are, I am inclined to think, confined to its investing membrane, which, as before noticed, is derived from the internal coat of the vesicle, and reflected over in the same manner as the pericardium is over the heart.

Of the office of this organ, or to what function it is subservient, I have but recently been enabled to form a rational opinion. In 1833, just after I first discovered it, possessed with the then prevalent idea that the four suctorial cups were mouths, I conjectured that this pendulous body and its appendages were portions of an alimentary canal,* cæca, for

* London Medical Gazette, 1833, vol. xiii. p. 205.

instance; but in 1845, I was so fortunate as to find, upon opening a large hydatid, a cluster of young ones sprouting from the upper part of the pendulous body, and, in addition, one about midway down its length, and also another at its extremity; these are well exhibited in fig. 6, but they are magnified about two diameters. In fig. 7 may be observed a single young hydatid, considerably developed, and at the upper part of the pendulous body also, which is seen floating from behind it.

I have before adverted to the circumstance of the organ from which the young are seen to sprout, not being in every instance found suspended in the vesicle, but lying enveloped in its internal coat. I possess a specimen with two or more young ones sprouting from filaments connected with an organ thus circumstanced. I have also met with instances where the young are being developed at a greater distance from the germinating organ than even in the last specimen; and in these examples, also, a slender filament may, with a pocket lens, be traced passing from the young hydatid towards the upper part of the pendulous organ.

What office, then, does this organ perform in the economy of the parasite? From the examples above given, of the development of young hydatids within its confines only, I cannot but infer that it is a special reproductive organ; and as in those instances where the young are apparently sprouting from remote portions of the vesicle, filaments may be traced connecting them with the principal organ, I propound, as a legitimate inference, that a special organ for reproduction *is* provided in the genus Cysticercus, and that the germinating function does not appertain generally, throughout the parietes of the vesicle, as in Cœnurus. With this view of the function of the organ, I venture to denominate it a *Gemmarium*, and, for the convenience of demonstration, the more slender extremity and filaments, with or without tufts, I designate the *fimbria* (fig. 4, *g*).

*On the nutrition of the entozoon.*—Helminthologists having

ascertained that the Cysticercus did not possess suctorial *mouths*, they then considered that it must be by imbibition throughout the whole surface of its vesicular body it received its nutriment. In a preceding part of this paper I have shown that the enclosing cyst of the hydatid holds within it a fluid, in quantity more considerable than is required for mere lubrication, and in quality eminently fitted for the nutrition of so simple an animal. It is therefore highly probable, that the parasite does derive its nourishment from the fluid of the cyst, which it calls forth, or rather excites the secretion of when required, by irritating the interior of the cyst with its armed proboscis. The fluid of the cyst is composed of serum, having apparently a smaller proportion of water than that of the blood, and of oil-globules, &c. By *endosmosis* the hydatid imbibes the more attenuated particles of it, to the exclusion of the more *granular* particles of the albumen, as unfitted for the delicate structure of the entozoon, and, as it appears from Matteuci's experiments, ill-adapted for endosmosis. I have been led to this explanation of the mode of nutrition by the following facts: first, the large proportion of albumen in the secretion within the *cyst*; and second, the small trace of it in the fluid of the *vesicle* of the worm. But from whence, then, is derived the material for the *solid* structures of the entozoon? From the fluid of the *cyst*, also, in the first instance, undoubtedly; and as the fluid of the vesicle *does* contain some albumen, if we acknowledge the aid of *catalysis*, the material for the granular internal and fibrous external coats will be readily furnished. Endosmosis carries the materials, catalysis eliminates them, and exosmosis deposits them. It appears to me, indeed, that it is only by the aid of endosmose and exosmose we can explain the growth of animals so low in the scale of organization as not to possess vessels of any description.

On the *reproduction* or propagation of the cystic entozoa generally, we have still much to learn. With respect to the species particularly under our notice, my observations have

enabled me to contribute some additional information in this division of its economy. As regards its *dissemination*, we remain in utter ignorance. Whether these entozoa are generated as ova or gemmæ it matters not: incarcerated as they are, their mode of escape and dissemination is at present a sealed book.

In reference to their reproduction, Mr. Gulliver has considered his *oval corpuscles* to be ova; Mr. Busk and myself, after careful and repeated examinations, are satisfied they are not so. Mr. Goodsir speaks of ova in the pedicles of the Cœnurus cerebralis; but no one can doubt, on perusal of his observations, that he also has mistaken the oval corpuscles for ova: as they possess similar characters to those of the Cysticercus, he has unquestionably fallen into the same error as Mr. Gulliver; therefore, the elaborate description of the process of their development by Mr. Goodsir* I can only contemplate as exceedingly imaginative. But M. Klencke, in this matter, has surpassed all other helminthologists in successful and felicitous experiments and observations: he has not only seen and measured (!) the ova of Cysticerci in the blood of animal, but, *mirabile dictu*, has propagated and disseminated the Echinococcus by *inoculation*! I cannot better exhibit to you the degree of estimation in which his opinions are held by his continental brethren, than by quoting the words of Professor Siebold, of Freiburg, from his "Report on Helminthology," for 1843-4:†—"It is to be hoped that Klencke will desist from these researches, which he has, in a short time, so completely exhausted, and the results of which have advanced to such an extraordinary extent our present possible knowledge, and relinquish a field, the praiseworthy and careful cultivation of which by other naturalists, though but slow, will be attended with more permanent results."

Professor Owen, and also most naturalists of the present day, consider all hydatids to be reproduced by gemmæ only.

* Anatomical and Pathological Observations, p. 90.

† Reports on Zoology, translated from the German, and published by the Ray Society. 1847.

This eminent zootomist observes, "No trace of a generative apparatus has hitherto been detected in the cystic entozoa. They would seem to be gemmiparous, and to have the reproductive power diffused over the whole cyst (*vesicular body*); at least in the Acephalocysts, in which the young are not developed from any special organ, or limited to any particular part of the cyst."* Such a mode of reproduction certainly obtains also in the Cænurus, as I am enabled to show by a pregnant specimen of Cænurus from the rabbit, in my possession; but, in the genus Cysticercus, I have shown that a special organ is appropriated to the generative function, instead of its appertaining to the vesicle generally—a step in advance in the scale of organisation. In the reproduction of the Cysticercus, we have, at present, been able to show only one process by which its species is propagated—that is, *gemmation*; it has, at the same time, been demonstrated, that the gemmæ are developed *within* the parent; it is, therefore, manifest, that no *dissemination* of the species can be effected by this mode of reproduction and development; even had the development taken place from the *exterior* of the entozoon, its dissemination would not have been facilitated a single step further, unless indeed, very simple ova,† or perhaps embryonic gemmæ, are extruded from some external part of the entozoon into the cavity of the cyst, and of such infinitesimal size as to allow of their being taken from thence into the general circulation of the infested ani-

* Dr. Todd's Cyclopædia of Anatomy and Physiology, vol. ii. p. 137.

† "No germinal vesicle has (we believe) yet been detected in the ovum of the hydra; and it seems to be questionable whether the entire ovum is not really homologous with the vesicle of Purkinje, which may itself contain a store of nutriment, adequate to the development of so low and simple a creature, without the additional supply furnished by the yelk in which this vesicle is elsewhere imbedded. It seems to be clearly established, however, that this separated body contains the essential parts of a true ovum, and is altogether distinct in its character from a *bud*."—See the article on the Development and Metamorphoses of Zoophytes, in the British and Foreign Medico-Chirurgical Review for January 1848, page 197.

mal, to be deposited in other parts of it, and also to be carried to its posterity.* But, I am entering the wilds of conjecture; still, as zoophytes are known to propagate by ova as well as gemmæ,† we may surely be permitted to imagine that the vesicular entozoa may do so likewise.

In the specimen, fig. 7, where the young hydatid is considerably advanced in growth, I cannot discover the proboscis. Does its formation await a further development of the entozoon? or are we to look upon this offspring as a "*nurse*," and admit it as an instance of "alternation of generations," according to Steenstrup? Not having seen a sufficient number of gradations of growth in the young of the Cysticercus to determine this point, I can only state with reference to it, that, in the development of the young of the Cænurus of the rabbit, the *proboscides* are visible in *all* the young (and several generations occur upon one common parent), and at an early period of their growth.

Of the exciting cause of, or the circumstances which mediately lead to, the *generation* of hydatids in animals, nothing certain is known; but it has very long been believed that an unsound or innutritious diet is productive of their appearance. Mr. Lawrence long since stated,‡ that the Cysticercus cellulosæ does not occur in the *wild* hog, although it is not unfrequently met with in the tame animal, constituting *measly pork*; we must, therefore, conclude that domestication (probably through its food and confinement) exerts considerable influence in their production. It is, likewise, a well-known fact, that monkeys and animals of the deer kind, when kept in menageries and consequently placed in an unnatural condition, are very obnoxious to the generation of vesicular entozoa in their viscera and cellular tissue.

* With the aid of the microscope, I have repeatedly searched for ova in the secretion of the *cyst*, but never discovered anything resembling them.

† Brit. and For. Med.-Chir. Review for January 1848, page 196, line 14, et seq.

‡ On Monstrous Productions, in the Trans. of Med.-Chir. Society, vol. v., first series.

I have myself caused the Cysticercus pisiformis to be developed in the omentum of rabbits, by feeding them on cabbage leaves alone; an experiment made many years since by the celebrated Jenner. A highly intelligent occupier of a warren has informed me that *bladdery* rabbits are most numerous in dry seasons, when the herbage is necessarily short and scanty; *bladdery* rabbits are those infested with a Cœnurus in the inter-muscular cellular membrane of the trunk and extremities.

It has been stated, that in sheep fed on salt-marshes Acephalocysts are not generated: on this point I can only observe, that sheep are never fattened on salt-marshes; and that sheep fed as lambs on salt-marshes, and afterwards fattened, *are* infested with the Cysticercus tenuicollis: also from my inquiries, I am led to believe that sheep fattened on a luxuriant and sound herbage are much less frequently infested with the vesicular parasites. Dr. Budd, in his admirable work on the "Diseases of the Liver," makes the following remark:—"Hydatids are met with in all conditions of life; but seem to be more frequent among the poor than among the rich."*

Having now communicated the extent of my knowledge on the anatomy and physiology of this entozoon, I purpose to offer a few brief observations on the morbid changes which not unfrequently take place in it. It has long been remarked that this Cysticercus is every now and then found dead, and when so circumstanced is invariably enclosed in a thickened cyst. A somewhat recent writer upon this subject, the late Dr. Houston, elaborately and accurately described the changes occurring in the cyst, and attributed them to the previous death of its inhabitant. My own observations have led me to arrive at a different conclusion. It has occurred in my researches, that the cyst must have arrived at a considerable degree of thickness before the hydatid died, judging from the slight change in the latter. I have also taken living hydatids from thickened

* Op. cit., page 360.

cysts; and we may easily conceive that when, from its thickened state, the cyst is no longer dilatable, its living tenant could no further grow, and it would die in consequence. What then, it may be asked, is the exciting cause of the thickening of the cyst? I reply—the constant demand upon it, of food for its inhabitant, leading to the frequently repeated irritation of its interior by the armed proboscis of the parasite. I have been partly led to adopt this opinion, from having found pus-globules in the viscid secretion of the cyst—a sure indication that something more than a healthy stimulus had been going on in that locality.

In the dissection of a cyst considerably advanced in morbid thickening, it will frequently be found more distinctly separable into two layers than in its normal condition, and it will be also seen that, while the outer layer is almost cartilaginous and consequently opaque, the inner layer remains in its originally transparent state; so much so, that without a previous knowledge of the circumstance, the latter might very easily be mistaken for the hydatid itself: such an occurrence must have taken place during Mr. Goodsir's inquiries into the structure of the cystic entozoa, or he could not have given the following description of the cyst of the Cysticercus. He commences his section (VI.—Of Cysticercus) in these words: "Cysticercus is distinguished from Cænurus by its sac (vesicle) having only one pedicle; it is also always contained in a cyst, which, in some cases, is formed from the compressed textures of the infested animal; while, in others, it consists of two membranes, viz. one similar to that mentioned, and another *sui generis*, and belonging entirely to the parasite." * The idea of an inner membrane of the cyst, *sui generis*, and belonging entirely to the parasite, is so incompatible with the great characteristic of the entozoa, viz. their independent existence manifested by their state of insulation, that it is marvellous so distinguished a zootomist should have overlooked the connection by vessels existing

* Anatom. and Pathol. Observations, page 91.

between the opaque outer layer and the transparent inner layer of a thickened cyst.

Morbid action progressing in the cyst would naturally lead us to expect the occurrence of morbid changes in the hydatid, and such I have found to be the case. A mere exaltation of the irritation previously noticed would inevitably be productive of a supply of noxious food, which again must furnish a deteriorated material to the growth of the recipient, and the necessary consequence would be a departure from the healthy structure, and even disease unto death of the parasite. The degree of condensation of the cyst to a certain extent governs the deviation from health of its tenant; thus, in a slightly-thickened cyst the textures of the hydatid will be found somewhat opaque only, and the hydatid still living; in a cyst thickened to a higher degree the hydatid will be found dead, with its vesicle burst and shrivelled up. I have in my possession two specimens illustrating these anormal states, which are faithfully delineated in the accompanying drawings. Fig. 8 exhibits a very elongated *gemmarium*, thickened and opaque from a redundant deposit of granular albuminous matter, and also an opacity of the parietes of the vesicle from the same cause. Fig. 9 shows a much greater extent of disease; the *gemmarium* is completely enveloped in albuminous matter, and from the fimbria radiate fibres of the same material to various parts of the vesicle; the latter is opaque, and dense white patches of calcareous matter are scattered about it. In this example the hydatid was found burst and collapsed. The containing cyst was as firm as cartilage, and its interior was lined with a coarse calcareous and granular matter.

In conclusion, I cannot but observe that there is still much which is interesting and instructive to investigate relating to the Cysticercus tenuicollis; and not the least important, I beg leave to suggest, is the generation of their ova (if required for propagation), and the mode by which they or the gemmæ are disseminated.

Let me not omit to acknowledge the valuable services of

Mr. Busk, by whose assistance I have been enabled to speak more confidently of what I have *seen* in my dissections of this entozoon.

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## EXPLANATION OF PLATE II.

Fig. 1. A diagram exhibiting the anatomy of Cysticercus tenuicollis.—*a*, the crown of hooklets; *b*, the suctorial cups; *c*, the proboscis; *d*, the external coat; *e*, the internal coat; *f*, the gemmarium; *g*, the fimbria of the gemmarium; *h*, the septum between the cavity of the vesicle and the interior of the proboscis, formed of the internal coat.

Fig. 2. Patch of oval corpuscles; see page 223.

Fig. 3. Portion of the coronet of hooklets (magnified) in position.—*a*, bifid process of the short hooklets; *b c d*, three hooklets lying in their natural position when expanded; *e*, the manubrium; *f*, the claw; *g*, the conical process.

Fig. 4. The Cysticercus opened longitudinally, exhibiting the *gemmarium*.—*f*, the gemmarium; *g*, the fimbria, a bristle placed under the portion of the gemmarium within the proboscis.

Fig. 5. The anterior portion of a Cysticercus laid open, showing a gemmarium with two or more off-sets, viz. a long central portion, a short lateral off-set, a recurved off-set, and others less distinct.

Fig. 6. A large Cysticercus opened, exhibiting a cluster (I counted nine) of young ones at the upper part of the *gemmarium*, a single one about the middle of its length, and another near its extremity.

Fig. 7. A Cysticercus opened, having a young one, considerably developed, hanging from the upper part of the gemmarium, the inferior portion of the latter floating beside it.

Fig. 8. A diseased Cysticercus, its coats and gemmarium thickened and opaque, particularly the gemmarium.

Fig. 9. A dead, ruptured and shrivelled Cysticercus, taken from a very thickened cyst. Its coats are studded with patches of *calcareous* matter; and the gemmarium is enveloped in granular albumen; also fibres of similar matter are seen radiating in various directions from the fimbriæ to the parietes of the vesicle. See page 236.

Fig: 3.

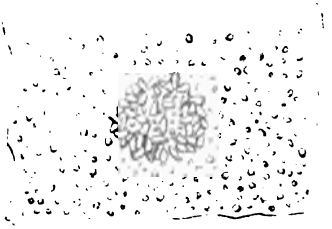


Fig: 2.

Fig: 4.

Fig. 1.

Fig: 6. Fig: 5.

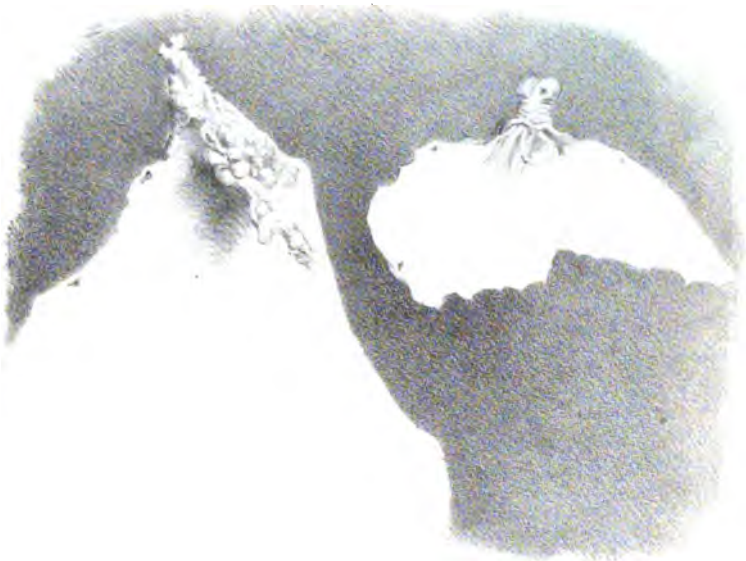


Fig: 7.

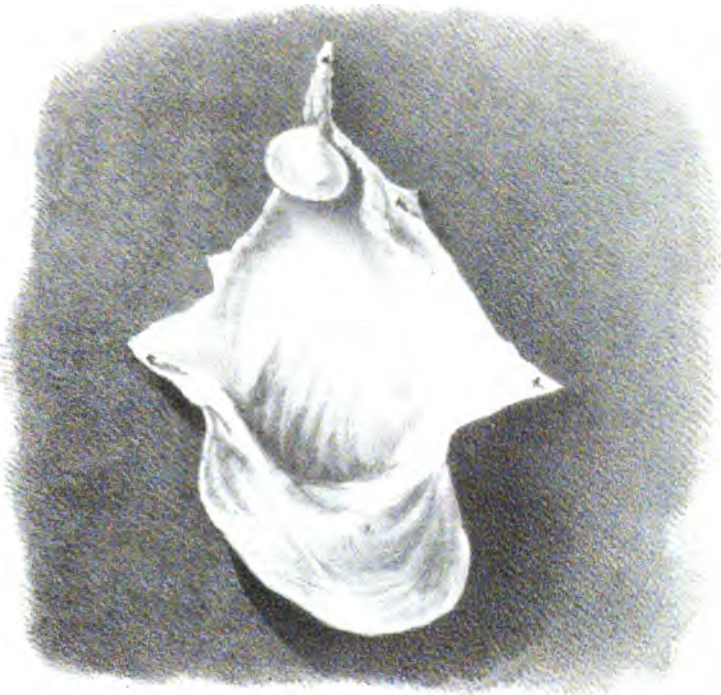


Fig. 8.

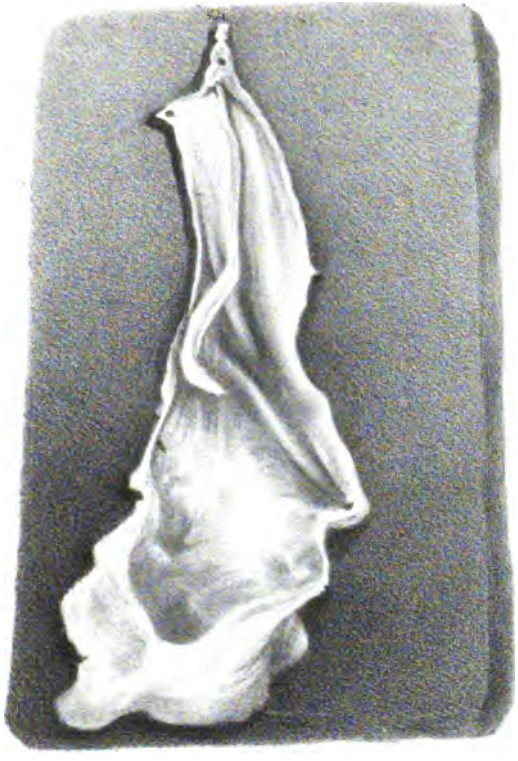
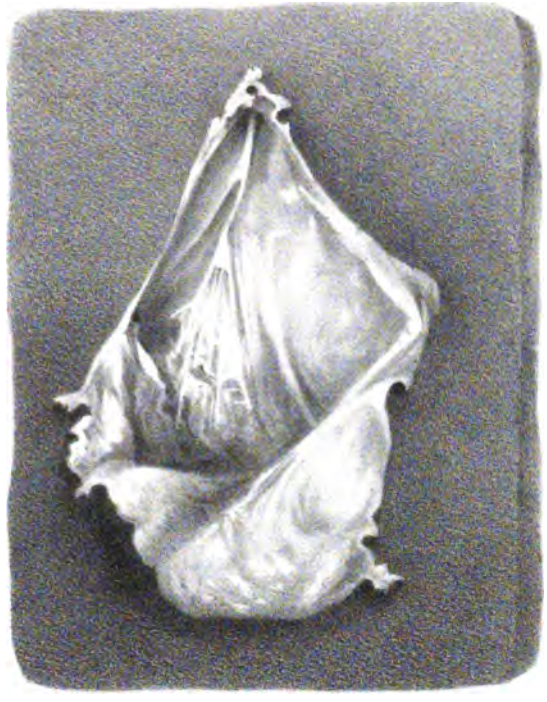


Fig. 9.



G.J. Rose del. H. George lith. 54, Hatton Garden

# DESCRIPTION

OF THE

# DISSECTION OF A BRAIN,

IN WHICH THE

## CORPUS CALLOSUM, FORNIX AND SEPTUM LUCIDUM WERE IMPERFECTLY DEVELOPED.

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Communicated by JAMES PAGET, Esq.

Received April 24th—Read May 23rd, 1848.

In the summer of 1847, whilst dissecting the brain of a boy, who died of pleurisy in St. Bartholomew's Hospital, I met with a remarkable deficiency in the development of the corpus callosum, an account of which may be interesting to this Society.

Nothing unusual was discerned in the shape of the skull, or in the condition of the dura mater; and in size, weight, and external appearance, the brain itself was normal. On separating the anterior lobes, however, it was at once apparent that there existed a very unusual condition of the corpus callosum, of which a considerable portion was wanting anteriorly. Upon observing this condition, the cerebral matter was carefully sliced down to a level with the corpus callosum, and, a rough sketch of the appearances being made, the brain was immersed in strong alcohol, for the purpose of hardening it. At the expiration of several months, when the spirit had rendered it tolerably firm, Mr. Paget kindly assisted in making a minute examination of its structure,

and in recording those appearances which seemed most worthy of note.

In its general proportions, the brain approximates to the healthy standard, the convolutions presenting the usual form and arrangement. The antero-posterior diameter of the cerebrum, in the middle line, is six inches and eight-tenths, and the transverse diameter of each hemisphere, three inches. The greatest transverse diameter across the anterior lobe is two inches and six-tenths, the same admeasurement of the posterior lobe being two inches and seven-tenths.*

On gently separating the hemispheres, the inner parts of the anterior halves of the lateral ventricles are exposed, traversed by the anterior cerebral artery, running in its ordinary direction from before backwards. The lateral ventricles lie widely open, there being no vestige of a membrane covering them, though it is probable that something of the kind must have existed during life, and have been torn away in removing the brain from the skull. In the place of the corpus callosum there appears, in this view, above the cavity of the ventricles, only such a transverse band of medullary matter as might represent its posterior half. The antero-posterior length of this imperfect corpus callosum, measured in the mesial line, is only one inch and a half, there remaining, from its front or anterior border to the anterior margin of the anterior lobe, a space of not less than three inches and a quarter. The posterior margin of the corpus callosum is distant two inches from the posterior border of the posterior lobe. This posterior margin, which is two-eighths of an inch in width, is as smoothly rounded as usual, and is in thickness one-eighth of an inch, whilst that of the anterior border is only one-twelfth of an inch.

The anterior border of the corpus callosum is continued

* The drawing which accompanies this paper, by Mr. Delamotte the Librarian to St. Bartholomew's Hospital, very correctly represents the appearances, after the upper part of each hemisphere had been removed, and portions of the brain had been peeled off to show the course of its fibres.

forwards on each side in a thin rounded margin; these, as they proceed, at first diverge, and then, converging and bending downwards, become continuous with a portion of white substance representing the knee and inferior reflected portion of the corpus callosum. In this way is enclosed a space or fissure, in the position usually occupied by the middle of the anterior half of the corpus callosum, the septum lucidum and anterior part of the fornix. In form, this fissure is nearly quadrilateral, and in dimensions as follows:—Its length 1·9 of an inch, its width in front ·85, and behind ·45 of an inch. By this means the cavities of the lateral and third ventricles are widely exposed, so as to exhibit the following parts: in front and in the middle are seen the upper surfaces of the knee and inferior reflected portion of the corpus callosum bending backwards; on each side of this are the inner parts of the corpora striata; and behind the anterior commissure, parts of the anterior crura of the fornix, and the anterior or inner portions of the optic thalami, with the cavity of the third ventricle distinct between them.

The firm condition of the brain permitted a tolerably accurate examination of the course and arrangement of the fibres composing the corpus callosum, which was, of course, both interesting and important.

The fibres which enter into the formation of the posterior and entire portion of the corpus callosum run in a transverse and parallel direction into the masses of cerebral substance on each side, exactly as is usual in a healthy brain: those of the posterior free margin, however, after proceeding in a like manner outwards into the substance of the hemispheres, bend backwards and diverge somewhat, and then seem to re-unite so as to enclose the cavity of the posterior horn of the lateral ventricle. The fibres anterior to these in position pass into the substance of the brain, first transversely, then forwards, and then sweep downwards by the outer borders of the corpora striata and optic thalami.

That part of the corpus callosum which is perfect on each side of the fissure seems to be composed of fibres, all of

which run in the usual course, transversely outwards, the most anterior taking a direction forwards and downwards into the substance of the anterior lobes, affording, as in the case published by Mr. Paget, in Vol. xxix. of the Transactions of this Society, an additional confirmation of the correctness of Burdach's remark, that "many fibres from an anterior part of one hemisphere go to a somewhat more posteriorly situated part of the other."

It is interesting to trace, in a vertical section of the brain along the mesial line, the posterior and perfect border of the corpus callosum reflected downwards and forwards to be connected with the fornix, which, however, is very imperfect in condition, insomuch that it is not more than half an inch in length, and extends no further forward than the transverse lines marking the junction of the anterior and posterior horns of the corpora quadrigemina. The sides of the fornix are continued on each side into a tenia hippocampi, but its soft condition rendered it impossible to trace its continuity with the convolutions of the hippocampus. The imperfect portion of the corpus callosum also consists of transverse fibres, from the under portion of which their laminæ can be separated, and which are traceable downwards to the lamina cinerea, and appear to consist of longitudinal fibres.

From the description which has been given, it will easily be understood that there is no sign of a septum lucidum or fifth ventricle, and that it is principally the middle and anterior portion of the fornix which is wanting.

The patient whose brain exhibited this peculiarity of structure was named Thomas Platt, and at the time he died was fifteen years old. He was brought up and educated at the Foundling Hospital, a circumstance which, while it afforded an opportunity of ascertaining the condition of the boy's own mind, necessarily precluded the possibility of obtaining any evidence as to that of his parents.

He is described, at the hospital, to have been civil and well-conducted, but exceedingly slow in acquiring knowledge in the school. About three years before his death, he

received a serious injury to the head from the blow of a cricket ball, which confined him to the hospital for twelve months, at the expiration of which time he had completely recovered his usual health, and was apprenticed to a cabinet-maker. I could not learn that either his character or his intellect was at all affected by this accident.

The person to whom he was apprenticed informed me that the boy could read and write well when required, though prone to fall asleep when thus occupied, a propensity which was a constant subject of ridicule with the other boys in the shop. It was found extremely difficult to teach him his trade, or to engage him in any mental exercise; though in making bargains and in obtaining full value for his money he showed a remarkable degree of acuteness. When suddenly questioned upon any subject he would appear bewildered, and require some moments consideration before being able to give a distinct reply, exhibiting in this, as in other respects, rather a sluggishness than an actual deficiency of mind.

Mr. Paget's paper on "Imperfect Corpus Callosum" entered so fully into the literature of the subject, as to leave no field for further research, there not having been, as far as I am aware, any cases recorded to which he has not alluded; and with regard to the physiological and metaphysical inquiries arising out of their consideration, I have purposely refrained from referring to them.

It is a point worthy of observation, however, that the mental condition of the patient whose case forms the substance of this paper presents, in several particulars, a complete antithesis to that of the girl who fell under Mr. Paget's notice. Neither of them can be said to have been of healthy mind, and yet the mental deficiency was of an opposite character in each.

In the girl, the peculiarity was "vivacity, and a want of caution, showing themselves in a habitual rapidity of action, and want of forethought, deliberation and attention;"

whilst in the boy it was a disproportionate degree of caution and want of vivacity, showing themselves in an extreme slowness, amounting almost to stupidity.

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## EXPLANATION OF PLATE III.

This plate exhibits the relation of the various parts, as described in the preceding paper on "Malformation of the Brain."

W.A. Delamotte, del

B George, lith. 54, Hatton Garden

REPORT OF A CASE

IN WHICH

# GASTROTOMY

WAS PERFORMED FOR THE RELIEF OF OBSTRUCTION OF THE BOWELS.

By ROBERT DRUITT, F.R.C.S. E.

Communicated by THOMAS PEREGRINE, Esq.

Received May 9th—Read June 13th, 1848.

James D., a delicate boy, aged 11, had, at the end of February 1848, an attack of inflammation of the bowels. The symptoms were those usually observed; namely, pain and tenderness (principally affecting the right hypogastric region), vomiting and constipation; and these symptoms readily yielded to the usual remedies; namely, leeches and fomentations, calomel and Dover's powder in small repeated doses, and subsequently castor oil and injections.

On Saturday, the 1st of April, I was again requested to see him. He was suffering from shivering, pain in the abdomen, and vomiting of sour greenish matter. The urine was scanty and irritating, the tongue furred, and the pulse quick. He had been exposed to cold and fatigue on the Thursday preceding.

I again resorted to the remedies which I had used on the previous occasion, but not with the same success. The pain and tenderness were somewhat alleviated under the use of leeches, bran poultices, and calomel and Dover's powder in

small repeated doses; but the vomiting continued, and the stomach rejected everything that was swallowed except the calomel and small quantities of soda-water and milk. The bowels too were excessively obstinate. Castor oil, when administered, was vomited, and injections, which were carefully used under my own superintendence, brought away only a very few small fragments of feculent matter. On Wednesday, the 5th, a lump of colourless mucus came away; but, after this, there was no discharge from the bowels whatever. The last full evacuation was on Thursday evening the 30th of March.

From Wednesday the 5th to Saturday the 8th of April, the patient took half a grain of calomel twice daily, and at night half a grain of opium. There was no vomiting so long as only a very small quantity of liquid was swallowed; but the bowels were still constipated. The belly was tense, but not so tender, and only in pain at intervals. The patient complained, when the belly was carefully examined, that he felt a *swelling below and to the left of the navel*, whilst the chief spot where pain and tenderness were felt, was exactly beneath the situation of one particular leech-bite, *below and a little to the right of the navel.*

On Saturday, April 8th, I thought it right to try the effect of small doses of colocynth and henbane, repeated frequently. They, however, brought on a return of most distressing vomiting; the matter rejected being a yellow liquid of a most offensive stercoraceous smell.

On Sunday, the 9th, I had the advantage of a consultation with my friend Mr. Thomas Peregrine. The patient was in much pain, excessively exhausted, and apparently moribund; and was still harrassed with the stercoraceous vomiting. Mr. Peregrine agreed with me in repudiating the use of purgatives, and in recommending small doses of opium to allay pain and irritation.

Monday, 10th.—The patient much easier: no vomiting since last night; small quantities of milk and of wine and soda water are retained; he has asked for a crust. No eva-

cuation. Tongue cleaner, and red at the tip and edges. Pulse 90, feeble. On a careful examination of the abdomen, I could recognise what appeared to be the outline of the distended stomach in the epigastrium; below, and parallel to that, the outline of a fold of distended intestine; below that, and to the left side, another. The patient still pointed to the same place, immediately under a leech-bite, a little below and to the right of the navel, as the seat of his chief pain and tenderness. I felt convinced, therefore, that at this point the tube of the intestines was obstructed, and probably by some adhesion consequent on his former attack of inflammation; but the patient's condition seemed so hopeless that any interference by operation was not to be thought of.

On the 11th and 12th the patient's condition was in most respects the same, except that his strength was rather greater. The eye was brighter; the intellect clear; the pulse from eighty to ninety, and less feeble; there had been no more vomiting, and the stomach retained small quantities of soaked crust of bread and of wine. The urine was clear and copious; the tongue cleaner and slightly aphthous; the whole body greatly emaciated; the abdomen in the condition above described. The patient was subject to fits of colicky pain, attended by faintness and sinking: these were checked by wine and two-grain doses of soap and opium pill.

On the 13th, the condition of the patient being the same as I have just described, I had another consultation with Mr. Peregrine. It appeared to us that there were three courses which might be pursued. One was, to attempt to move the bowels by injections and purgatives. But I had already, without good effect, injected as much liquid into the bowels as could be done without danger of rupturing them: and it was evident that purgative medicines, administered by the mouth, would merely bring on a return of the vomiting, and could be of no avail against a mechanical obstruction. The second was, to let the patient die quietly. The third was, to attempt relief by a surgical operation. In favour of this last plan were the facts, that the patient lived on

from day to day, slightly improving, since Sunday; and that he pointed to one definite spot as the seat of his pain, where, in all probability, we should find a mechanical obstacle, if one existed. The parents of the boy were, therefore, told our opinion; and it was left to them to decide whether an operation should be attempted or not; they being fully informed that it afforded the only, although a most desperate, chance of relief.

One more valuable day was lost through their hesitation; but on Friday the 14th, they gave their consent. On that day, therefore, having again made a careful examination of the patient's condition, and believing that he had a sufficiency of strength to justify the attempt, we resolved to perform an operation for the purpose of finding, and if possible removing, the cause of the obstruction of the bowels.

Having taken care to have the apartment raised to a good temperature, and the patient having emptied his bladder of half a pint of healthy urine, I made an incision about two inches and a half in length over the linea alba, between the umbilicus and pubes, and cut carefully down to the peritoneum. This being opened, and found not to be adhering to the bowels, we passed in our fingers to the spot indicated by the patient; and, after separating a few slight and loose adhesions, and one tolerably broad and firm adhesion of adjoining folds, we came to a distinct band passing tightly over a portion of the intestines. Having, therefore, enlarged the wound upwards and downwards to the extent of about four inches, we proceeded cautiously to draw the constricting substance into view; when we found it to be a band —smooth, having a glistening peritoneal envelope, dense in its texture, and appearing to be either an unnatural appendage or else a very old adhesion. It was about three-quarters of an inch long, of the size of a common piece of red tape, and passed from one fold of intestine to another, binding down a certain portion of the intestine under it. Having satisfied ourselves as to its nature and passed a finger under it, we divided it. But now, whilst we were beginning to congratu-

late ourselves on having attained our object, we were dismayed at perceiving a stream of yellow feculent matter pouring up from the bottom of the peritoneal cavity. This complication, the cause of which was not obvious, convinced us at once that the case was hopeless. We deemed it our duty, however, to look for the aperture from which the feculent matter proceeded, and after a long and difficult search we found a large ulcerated opening which had evidently just given way. This was secured by a needle and ligature; the bowels, which we had caused to protrude in our search for the aperture, were returned, and the wound closed by sutures, plaster and bandages.

The patient began to sink shortly after the operation, and expired in two hours and a half. We did not use the chloroform, because the patient was subject to epileptic fits. The amount of pain suffered was very trifling, till the feculent matter came into contact with the peritoneal surface of the bowels.*

*Post-mortem examination.*—On Saturday the 15th, I examined the body, in the presence of Mr. Peregrine, and of Mr. Goodwin under whose care the patient had formerly been.

On laying open the peritoneal cavity, we found evident traces of inflammation, which had at some distant period affected the viscera on the right side. The omentum on the left side did not descend an inch below the great curvature of the stomach: on the right side it came down nearly as low as Poupart's ligament, and was connected to the peritoneum over it, and to the ascending colon behind it, by loose cellular adhesions. Similar adhesions connected the convex surface of the liver to the adjacent peritoneal surface. The gall-bladder, which was much distended, was connected by long and loose cellular bands to the ascending colon. Having next, on a

* The patient's mother says, that in the course of the last eight years he had suffered from distinct and severe attacks of illness, of which the prominent symptom was pain in the right side of the abdomen. These were generally healed by powders (probably calomel) and castor oil.

cursory inspection, noticed that the upper part of the abdominal cavity was occupied by the stomach, which was much distended, and the remainder by the convolutions of the small intestines, the transverse arch of the colon being quite contracted, and lying behind the greater curvature of the stomach, we proceeded to make a most careful scrutiny of the intestines. The rectum, the descending, transverse and ascending colon, were pale, contracted and perfectly empty. There was a web of very fine loose cellular adhesions surrounding the caput coli and vermiform appendage, and the last two or three inches of the ileum. The terminating portion of the ileum, for the extent of about twenty-five inches, was as pale, contracted and empty as the colon; but all the rest of the ileum and the jejunum, up to the duodenum, was reddened, enormously distended, and filled with liquid yellow feculent matter. The junction between the contracted and distended portions was well-marked and abrupt. At two points of the ileum, one of which was about a dozen inches above the contracted portion just spoken of, and the other about as much higher up the tube, we found the remains of the constricting band which we had divided during the operation. At one part, where probably we had divided the broadest band, the bowel looked as if a portion of the peritoneum had been stripped off. In two or three places near these, the bowel was roughened by very slight effusion of lymph. We next examined the ulcer which had given way during the operation. It was situated in the ileum, not far from the lower attachment of the divided band; and in the immediate neighbourhood we observed two or three other ulcerated patches. The mucous membrane around these was thickened, but there were no adhesions externally.

The liver and kidneys were tolerably healthy. The chest and head were not examined.

I think the above case shows clearly the possibility of forming a tolerably correct diagnosis of the situation of an obstruction to the intestines, and of reaching and removing it

without any very great difficulty. I very much regret that the operation was not performed a week earlier. If it had been, the ulceration would probably not have advanced so far, and the result might not have been so unfortunate. But I confess that as the case began with what appeared to be purely inflammatory symptoms, and as the patient had so recently recovered from an apparently similar attack, I looked upon the constipation at first as the ordinary accompaniment of inflammation; and it was not till after the inflammatory symptoms were mitigated, that those of mechanical obstruction became palpable.

I have requested my friend, Mr. Peregrine, to submit this case to the Royal Medico-Chirurgical Society, as a humble contribution to the series of similar cases, which have been brought before the Society by Mr. Curling, and Dr. Golding Bird and Mr. Hilton.

# CASES

# ILLUSTRATIVE OF SOME CONSEQUENCES

OF

# LOCAL INJURY.

By THOMAS HODGKIN, M.D.

Received June 2nd—Read June 27th, 1848.

Although amongst the examples which I am about to relate some appear to possess sufficient individual interest to be worthy of preservation, even in an isolated form, I have thought that their value might be increased by their being brought together for the illustration of a principle, though but little originality may be found in the comments appended to them.

When a local injury is known to have been inflicted, and the extent of mischief is ascertained, either as affecting some important organ or as implicating merely parts of less moment, various trains of symptoms are expected to follow in accordance with the results of experience in other cases of similar description. It is not my object to trench on the province of the surgeon by noticing such cases. There are also injuries which, though comparatively very slight in themselves, are attended with the operation of an influence capable of producing the most violent and acute symptoms, frequently causing the speedy death of the sufferer, and apparently dependent on some morbid poison either introduced from without, or generated in the patients themselves, in consequence of some temporary peculiarity of constitution. Of such cases, which have formed the subject of excellent articles on constitutional irritation, it is likewise my intention

not to speak, although much constitutional irritation was doubtless present in some of the instances to be given in this communication.

In the cases which I am about to detail, the local result of the injuries may be divided into two distinct groups—the one in which the effects had more or less the character of common inflammation, though probably not unconnected with the operation of a morbid poison; the other distinguished by the production of an adventitious structure, having the character of malignant disease.

*First Group.*

*Case* I.—R. M. was about 45 years of age, an active and energetic man of business, of spare habit of body. Though not appearing robust, his health had scarcely ever been interrupted. It was discovered, but not until after the examination of the body, that rather more than two months before his death he had fallen down upon the edge of the curb-stone in one of the streets of London, and had at the same time narrowly escaped being run over by a cabriolet. It did not appear that he was sensible of having received much injury by this fall. He seemed to think much more of his escape than of any mischief actually received, and was not detained from business by the accident.

About six or seven weeks after this, he was actively engaged one morning in aiding as well as directing the making of alterations in a part of his grounds, which much heated and fatigued him. In this state he went to town on the outside of a coach, imperfectly protected, and it is believed that he was exposed to wet as well as to cold. In the evening he looked chilly and distressed; he felt obstinately cold, and was disinclined for any exertion. He also felt severe pain in the right side, corresponding to the spot at which the effects of injury were afterwards discovered. Zealous attention to his business induced him, notwithstanding, to go to town, when he was again somewhat exposed to wet and cold.

The following day he was confined to the house; but after

this, business being brought to him by his clerk, he went through arduous mental exertions. A blister applied over the seat of pain, aperients and effervescing salines, afforded him considerable relief, and he made no more complaint of pain in the side, but continued in a febrile state, marked with great debility; yet he was able to eat, and partook of animal food. After an aperient, the pulse became extremely low and weak. Two half-glasses of claret, which afforded him immediate relief, were followed by a most disproportionate excitement. He was perfectly correct in the perception of facts, but reasoned erroneously upon them. He pronounced himself quite well, and would not take medicines or submit to remedial measures. From this state, which did not last long, he seemed much relieved by sleep. Slighter paroxysms occurred two or three times, but in the intervals he was perfectly rational.

On the second morning after the appearance of mental disturbance, he passed into a state of coma or stupor, with stertorous breathing, and a feeble and very rapid pulse. He appeared, in short, to be moribund. A small quantity of ammonia was introduced into his mouth, and swallowed, after which he considerably revived. He transiently complained of a little pain in the left arm and leg. The former he thought that he had sprained; the latter he supposed had been subjected to pressure, but it did not appear to have received any injury. On examination, a small partial induration was found near the calf of the leg; it was slightly sensitive on pressure, but seemed to be an affair of little moment. It slowly increased, and, the day before death, occasioned considerable pain. He also suffered, at the same time, from the effects of a sinapism once applied to his feet, which produced a little vesication. After the first appearance of mental aberration, and as soon as he could be prevailed upon to take medicine, small doses of calomel were given every three or four hours, with the occasional addition of a little tartarised antimony and an opiate. The next evening he was seen by Dr. Bright, in conjunction with his

former attendants, Dr. Hull and myself. The calomel was increased to two grains, given about every two hours. The antimony and opium were also directed to be continued; but, the prevailing disposition to sleep appearing to render them needless, they were given only twice and in small quantity. Thick cold arrow-root, water, and a little beef-tea, were almost the sole ingesta. The bowels were not active for two days, and the urine was secreted very sparingly. The bowels were afterwards copiously relieved by an enema. From that time they acted repeatedly, and became rather irritable. The kidneys and bladder acted more freely. The calomel was suspended, and the beef-tea and arrow-root continued. Until the patient's bowels had been relieved, he lay for many hours, without changing position, upon his back. He was afterwards moved from one bed to another, which, though it increased his comfort, greatly exhausted him. The head was generally hot, requiring evaporating lotions. The face was rather flushed; the expression of countenance was generally composed; the breathing, though quick, seemed easy, and without movement of the alæ nasi. There was however, at times, a little stertor during sleep or somnolence. When the latter state was most profound, the pupils were remarked to be greatly contracted. The tongue was generally moist, with a white fur on its surface, which, on one occasion, was rather thick. There was no preternatural redness of its tip or edges. The pulse was regular, but inordinately quick—generally 120, sometimes upwards of 130, rarely 110, but, on one occasion, a little lower. The resonance of the chest and the respiration were quite natural. The abdomen was generally free from tenderness or tumefaction, but, within a short time of death, there was a little distention. Vomiting also occurred twice or three times before death. Small pustules, or maturating vesicles, on the body and limbs were only noticed a short time before death. The skin was often of a genial warmth, but not in a profuse perspiration. From twenty to twenty-five grains of calomel had been given.

The *examination* was made about twenty-four hours after death. The body was thin, and, about the extremities, might almost be considered as emaciated. On different parts of the trunk and extremities there were scattered a few small vesicles, filled with puriform fluid. They resembled ecthyma, without the areola. There was a small subcutaneous tumour near the head of the right fibula. It was soft, and, when opened, gave exit to a little thick, soiled pus. A tumour of a similar character, but much larger, at the upper part of the left calf, was not opened.

The dura mater appeared to adhere with more than the usual firmness to the calvaria. Nothing remarkable was observed in the arachnoid. There was but a small quantity of serum beneath it, and the pia mater seemed to be more closely applied to the surface of the brain than is usual, but was readily removed from it without lesion. The external layer of the cortical substance might be separated in pieces of considerable size from the subjacent layer. Incisions into its cortical substance, nearly at right angles to its surface, exhibited the layers of the cineritious substance, at some parts, very distinctly; and, at one particular spot, there seemed to be an evident, but very partial, softening, by which the separation before mentioned was favoured. The substance of the brain generally appeared healthy. There was only a moderate quantity of fluid in the ventricles.

The right pleura was generally free from adhesions, and perfectly so at the anterior part, at which the lungs and pleura appeared quite healthy, except that the former might be rather too pale from a general slight emphysema. There was some old partial pleuritic adhesion posteriorly and laterally. There was besides, the evidence of recent pleuritis near the same spot, which was the seat of the following very remarkable morbid appearance: The pleura costalis corresponding to one of the ribs, probably the fifth or sixth, from its anterior extremity to its angle, as well as that corresponding to a greater part of the intercostal space, immediately above and below, was elevated by purulent deposits of various

sizes, generally assuming a rounded figure, but much disposed to be confluent. Few, if any, had perforated the pleura; but the opposed pleura pulmonalis, as before stated, was at this part, which corresponded with the interlobar fissure, slightly attached, by adhesion and presented several purulent deposits resembling those beneath the pleura costalis: it cannot be positively stated, whether they were here upon or beneath the serous membrane: it is believed that they occupied both positions. The immediately adjoining portions of both lobes were in a state of recent hepatization. On turning back the integuments from the right side of the chest, the muscular structure corresponding to the before-mentioned internal disorganization was found to be thickly sprinkled with similar but smaller purulent deposits. The left pleura exhibited no trace of old or recent inflammation. The pleural cavity was remarkably free from fluid. The lung was generally crepitant and of a pale colour, being slightly emphysematous. The heart and pericardium were quite healthy.

There was a small quantity of semi-transparent lymph between the convolutions of the intestines at the lower part of the middle region of the abdomen; but there was very little fluid effusion. There was no appearance of old peritonitis. The mucous membrane of the stomach was considerably reddened with dendritic injections towards the cardiac extremity. In other parts there was a little dusky discoloration; but the most remarkable appearance was that of numerous small, scattered depressions, occupying several square inches at and near the small curvature of the stomach. They were probably the enlarged orifices of follicles, and their number and relative situation favoured this idea, since these spots appeared to correspond with other appearances which have been regarded as connected with follicles of the stomach. In the deepest of these depressions there appeared to have been a loss of substance, which seemed the result rather of solution than of ulceration; a circumstance which further favours the idea of their depending upon follicles.

*Case* II.—On Friday, the 24th of March, T. F. called in

the assistance of his medical friend, in consequence of a smart pain, occupying a space scarcely larger than a sixpence, a little below the right knee on the outside. Although the pain was of a distressing description, nothing was discovered by the sight or touch, nor was there any notable tenderness on pressure. The patient made no complaint of ill-health, but his tongue showed that this was not perfectly good. He had felt the pain a day or two before, but not so as to prevent his going about; and in London, about ten miles from his home, he had taken a very smart dose of jalap. Fomentations were ordered, and a dose of alterative medicine. The pain, notwithstanding, continued unabated, although there was still no difficulty in moving the joint, and the general health was scarcely complained of. The application of leeches procured immediate relief.

There was, however, considerable languor and great debility; yet not such as to prevent the patient from driving himself three or four miles from his own house. This was just about a week before his death. Shortly after the application of leeches, first the knee, and then the limb generally, became considerably swollen, but no fluctuation or venous or lymphatic inflammation was discovered. Oppressive pain and tightness of the head being complained of, and evident febrile disturbance being present, blood was taken from the arm with great but transient relief. The crassamentum was loose and soft; it occupied the entire diameter of the vessel, and had a slight sizy coat. The pain and swelling of the limb increased with aggravation of the general symptoms, and some delirium came on. Dr. Dowler saw him in consultation, when it was determined to apply a moderate blister above the knee. Hæmorrhage from the nose occurred once or twice, and the general symptoms were those of low typhoid fever. A high degree of delirium was present for some time before death, and great oppression of breathing was likewise noticed. I was sent for on the morning of the 28th; but the patient had expired before I arrived. From the symptoms which were then detailed to me, I was induced

to suspect the formation of a purulent deposit from previous lesion, as in the case of R. M., and, on inquiring, was informed that T. F., about six weeks before his death, had repeatedly used great exertion in contending with a restive horse, in which he persevered, notwithstanding the fatigue and tremor which it caused. On one of these occasions the animal rearing, he either threw himself off, or fell upon a grassy bank, down which he rolled. He made little or no complaint of suffering from the accident, and continued his various exercises as before; and on one occasion had a day's fishing, when he was some hours walking and standing. Subsequently to his death, it was stated that some time prior to his complaining of pain near the knee, he had transiently exhibited an altered and peculiar state of mind. He was observed to disfigure a book which he had previously prized and preserved with the greatest care, and once or twice he transiently laid aside his usual kindness of disposition.

The inspection was made by J. J. Adams, in the presence of Dr. Dowler, J. Clark, and myself.

The arachnoid was rather thick than otherwise, but without conclusive evidence of recent inflammation. The pia mater was little injected, but infiltrated with serum. The brain appeared rather pale; the convolutions were deep, and their surface had a very irregular, slightly uneven or coddled appearance. In some parts the outer layer of the cortical substance readily separated as a pellicle. The substance of the brain appeared throughout remarkably healthy, was of good uniform firmness, and pretty readily separated in the direction of its fibres. There were some cysts on the plexus choroides on both sides, and a rather large quantity of serum in the ventricles.

The pleuræ were remarkably free from adhesions, there being only a few of old standing towards the lower part. The lungs themselves were very slightly emphysematous. Each, when cut into, was found to have a portion of a dark olive brown colour, infiltrated with fluid of the same colour, highly lacerable, and emitting an offensive and peculiar odour, not

precisely that of gangrene. Other parts of the lungs were of the ordinary livid colour, and infiltrated with bloody serum. A considerable warmth was perceived in the lungs, when every part of the body was nearly or quite cold.

The heart was rather large, and, like the rest of the body, loaded with fat. The muscular substance of the heart was rather pale, and easily lacerated, which was the character of all the tissues.

There was no appearance of peritoneal disease. The intestines were prodigiously distended with gas: their mucous membrane, as well as that of the stomach, appeared to be healthy. That of the stomach was slightly mammellated, and, at the termination of the ileum, the Peyerian glands were a little elevated, and of a mottled grey colour, indicative of some previous irritation there. The liver was tolerably healthy. The gall-bladder contained a small quantity of dilute saffron-coloured bile. The spleen was small, and in rather a collapsed state, its tunic appearing shrivelled, like that of a calf's spleen. Its substance readily broke down into a lilac-coloured grumous mass. No appearance of inflammation was observed in the femoral vessels. The subcutaneous fat, a little above the knee, was infiltrated with a dirty brown serum. A large collection of purulent matter was discovered, amounting to upwards of a pint. At the outer side of the knee, where it was most superficial, it was of the consistence of cream, and yellowish. More deeply seated, and nearly in contact with the periosteum, it was white, of a firmer consistence, forming, with the cellular membrane through which it was diffused, almost a solid body; whereas the cellular membrane connected with the other portion formed shreds, resembling wetted tow. Somewhat curdy puriform matter was contained within the joint, but it was not discovered to have any communication with the collection of matter external to it. The articular cartilage of the patella was soft, and of a semi-translucent yellow colour, somewhat resembling pale yellow soap, after it has been soaked in water. The cartilage on the femur and tibia was not so sensibly altered.

*Case* III.—The history of this remarkable case was not complete till after the inspection had been made. The large extent of sloughing cellular membrane, and the collection of imperfect pus, indicated however that some violent *local injury* had been received; and, after careful interrogation, it was ascertained that M. R., about three months previously, whilst in Switzerland, and being in a very early stage of pregnancy, met with a considerable strain, whilst ineffectually endeavouring to avoid a serious fall. At the time, and for some hours after, she felt great pain in her right side, but she insisted on no mention being made of the accident. She subsequently complained, at different times, of pain in the region of the spleen, and very frequently expressed her apprehension that she should not live long, although at that time apparently in good health. She connected this ill-boding with her state of pregnancy, of which she had entertained an extreme horror, and not with the injury which she had received. During her tour, a considerable fæcal accumulation was formed in her bowels, with which she returned home. She was afterwards exposed, without sufficient protection, to cold and draught. This was quickly followed by indisposition, of which the accumulation of fæcal matter, and the consequent bowel-irritation, were the prominent features. The unloading of the bowels was effected without much difficulty; but the expulsion of an ovum, at about the third month, which then took place, was preceded and followed, as well as accompanied, by very considerable and unusual pains in the right inguinal region, which seemed to have an inflammatory character, and suggested the application of leeches. Great irritability of the stomach came on, with urgent vomiting, which had at times a stercoraceous character: at least, the matter rejected was said to resemble the fluid evacuations which passed from the bowels. Both these symptoms were subdued by small doses of opiates, administered by the mouth and anus, by demulcents and mild mercurial doses.

The abdomen was not distended, and was much less sensi-

tive to pressure; but pain was felt in the back, and in the right leg, when it was moved; and a flexed position of both legs appeared to be grateful.

The throat was sore. The velum and fauces were covered with a white crust, which was easily removed by a sponge dipped in a weak solution of nitrate of silver; but it was quickly reproduced, and thus the malady extended to the other parts of the mouth. The breath had a peculiar odour, by no means offensive, and at first resembling that of an infant who has recently taken the breast; but it became progressively more saccharine, and resembled fresh-ground malt, and, a short time before death, had the smell of caromel, or burnt sugar.

The countenance was neither contracted nor collapsed, but was occasionally flushed. It was seldom indicative of pain, but the patient complained of a feeling of distress and sinking. A little wine at one time afforded relief, but the repetition of it could scarcely be borne. Opium in any form produced inconvenience, and hyosciamus had no good effect. But little sustenance could be administered, except in the liquid form, and in small quantities. Nearly a week before death, a very slight emphysematous crepitation was perceived under the skin, in the iliac regions. Soon after, the same symptom became more distinctly evident along the course of the back, extending as far as the nape and sides of the neck, where it was readily perceived by the patient herself, and produced a sound which was occasionally audible to the bystander. It seemed wholly unattended with pain, and except that the pulse, which had fallen to 100, or a little lower, generally maintained itself at 120, and was small, weak and soft, the symptoms appeared rather remitted than aggravated. Small doses of bark were given, as well as a little wine, and an increased quantity of food was taken and retained by the stomach; yet it was still chiefly confined to nutritious fluids in small quantities. The extent of emphysema appeared to diminish, though the quantity of air in the middle of the back was sufficient to render it quite tympanitic. It was suspected

that the air had made its escape from a small opening in the cæcum, at a part scarcely covered by peritoneum, so as to pass into the cellular membrane, over the iliacus internus; and a remarkable want of odour in the gas which at times escaped from the anus appeared to account for the absence of severe symptoms. The sore which was formed on the sacrum from pressure, in conjunction with the moisture which was occasionally present, caused pain and inconvenience, and showed no disposition to heal; yet some relief was obtained from nitrate of silver, and from a large soap-plaster, spread upon thick leather, which was applied to a great part of the back. The bowels acted almost spontaneously, scarcely requiring the assistance of a small warm-water enema. The fæces were nearly healthy, at times consistent, but on one occasion quite liquid. The urine, which was rarely deficient, was nearly clear, slightly reddish, and exhaled the odour of new hay, but did not yield anything saccharine when evaporated.

In the progress of the disorder, considerable emaciation took place, and there was a remarkable disappearance of the red particles of the blood, the tongue, fauces and conjunctivæ becoming extremely pale. There was scarcely any disturbance of the intellectual faculties when the patient was awake, or wandering during her sleep, till within the last thirty-six hours, when ptosis, and some other symptoms of oppressed brain, came on. Memory for words failed, rendering the speech incoherent. Prevailing somnolence was occasionally interrupted by screams, and the difficulty of breathing, which the state of the throat materially aggravated, continued for some time after consciousness was apparently at an end.

*Examination after death.*—The body was that of a tall, remarkably well-made female, very exsanguine, considerably reduced in flesh, though still retaining a fair amount of subcutaneous fat. No external signs of decomposition were apparent.

The head was not opened.

The lungs and pleuræ were remarkably healthy.

The pericardium contained a little fluid, but appeared to be healthy.

The heart was small, remarkably pale, and very flabby, containing no coagula, and very little blood.

The abdominal muscles, especially on the right side, were of a dark, dirty, livid colour, and soft. Towards the right hypogastric region, where their colour was the darkest, their fibres were laid bare, as if dissected. The softened, broken-up, cellular membrane was mixed with a dingy white semi-fluid material, almost grumous. The peritoneal surfaces, both of the parietes and of the viscera, along an irregular line extending a little above the crista of the right ilium, and following the course of the pelvis, but a little above it to the left inguinal region, were feebly glued together, so as to form small cavities containing a dirty whitish grumous substance, of different degrees of consistency. Quite on the right side there was a communication with the intermuscular cavity before mentioned. The grumous and curdy matter was accompanied with air, but with very little liquid. Over the pubes, in contact with the bladder and uterus, it was creamy and puriform. Between the uterus and rectum, the circumscribed cavity was most distended, and contained about a third of a pint of thin, turbid, very light-coloured fluid, mixed with curdy particles. On the left side it was much more limited, following the course of the broad ligament, and implicating the Fallopian tube and ovary. There was a very small circumscribed cavity of similar character, of which rather more than a square inch of the spleen and the corresponding parietes formed the sides. The other portions of the peritoneal surface were effectually shut off from these cavities, notwithstanding the very feeble character of the adhesion by which they were closed. A few recent filamentous adhesions had, however, been formed between some of the convolutions.

The mucous membrane of the stomach was quite pale. No ulcer was seen in any part of the intestinal mucous

membrane. Towards the lower part of the ileum, it was dark and injected, especially along the edges of the valvulæ conniventes. The aggregate glands were barely perceptible. The ileo-colic valve did not exhibit any lesion of structure, but the mucous membrane there, as well as immediately above and below, was of a dark brownish colour. The contents of the intestines were healthy, but small in quantity. The last half-inch of the appendix vermiformis, which formed a part of the wall of the cavity before mentioned, was of a dark colour throughout, but not perforated.

The right ovary, which was large and flat, and the Fallopian tube, which was of a very dark colour, and which also formed a part of the wall of the cavity, were rendered very indistinct by adhesions and morbid deposit. The substance of the ovary appeared healthy, but pale and firm.

The uterus was rather large, in accordance with the recent abortion, of which the dark, livid and irregular mucous membrane bore the evidence. Its substance was quite healthy, but its peritoneal surface concurred in forming the cavity before mentioned.

The left Fallopian tube was more distinct than the right, but it was of a dark colour, and, towards its termination, large; and the character of the fimbriated extremity was lost in what appeared like an irregular circle of dark caruncles. The ovary on this side resembled that on the right.

The liver and kidneys were healthy; but the spleen, besides presenting the spot before mentioned, was large, soft and grumous, though not of a dark colour.

On tracing the cavity behind the peritoneum, on the right side, which, over the iliacus internus, communicated with the peritoneal cavity by several cribriform openings, it was found to extend along the whole course of the psoas muscle. It contained a considerable quantity of dingy white grumous material, which varied in consistence from that of the finest mortar to that of thickish whitewash, and was intermixed with numerous shreds of dead cellular membrane, like wetted tow, but seemed notwithstanding to be perfectly inodorous.

The posterior mediastinum appeared quite healthy, as well as the vertebræ, as far as they were examined.

*Second Group.*

*Case* I.—A man was drinking and smoking in a public house, when a scuffle occurred, in which one of the parties engaged pushed the smoker's arm so as to bring the end of his pipe with violence under one of his eyes. The end of the pipe was broken off, but the man was not aware that it was lodged in himself. The small wound under the eyelid completely healed. After a time he suffered so much in his head as to be admitted into Guy's Hospital. In about four months the man died; and, *on examination*, I found two inches of the tobacco pipe lodged along the side of the cavernous sinus.

The dura mater was raised at this part by a small mass of cerebriform matter, about as large as a wild cherry. It appeared to consist of one principal and several smaller tubercles closely in contact with each other. No production of cerebriform matter was discovered in any other part of the body.

*Case* II.—In the month of December 1826, F. H., a young man about 20 years of age, whilst carrying a barrel of herrings, weighing about 200lbs., made a slip, and, in recovering himself, injured his back. For some time after he felt pains in his limbs, and was unable to walk; but in two or three weeks he recovered this power. He could not carry a weight on one side only, but could do so on both at once, e. g. he could carry two pails, but not one pail, of water. He felt, however, unfit for work, and employed himself in going about with eggs. In the month of April, or the beginning of the month of May 1827, he began to feel pains in his legs, but first in the right, in which the pain extended as low as the knee: some time after the other also became painful. He walked with difficulty, and was unable to void his urine. In the month of June the loss of power in the lower limbs became complete, but sensation remained, and he at times

suffered severe pain in them. Continual recourse was had to the catheter for the evacuation of his bladder. The urine passed was latterly extremely offensive, and he had at times great pain about the region of the bladder. His bowels were rather costive; his general health did not seem to suffer much, yet he became greatly emaciated. His body was drawn forwards, and the spinous processes about the middle of the lumbar vertebræ presented a considerable and progressively increasing projection. There was, however, very little pain at this part except on pressure.

*Examination after death.*—The head was not opened.

The viscera of the thorax were in the most unblemished state; there was merely a small quantity of clear straw-coloured fluid in the pericardium, which had no appearance of inflammation.

There was a good deal of diffused redness throughout the alimentary canal; but it had more the appearance of congestion than of inflammation.

The bladder contained a thick puriform offensive fluid tinged with sanies. Its mucous membrane was of a dark livid colour, uneven and ulcerated. The parietes of the bladder, at the anterior part, were ulcerated through, and communicated with a small abscess in the cellular membrane.

One of the middle lumbar vertebræ was so crushed as not to be equal in thickness to the intervertebral spaces between which it was situated. The intervertebral substance seemed to have been little, if at all, injured by the accident.

Rounded masses of fungoid or cerebriform matter, somewhat larger than a chestnut, grew from both sides of the bodies of the vertebræ at this part. A small quantity of similar matter, but more mixed with blood, was found within the vertebral canal, which was rather contracted upon the cauda equina.

*Case* III.—The malady of W. C., aged about 28, might be dated about eighteen months back, when, in Madeira, he became troubled by the enlargement of the right testicle. Uneasy riding on mules appeared to be the exciting cause; yet it

must be stated that as much as eighteen years before, he received an injury from a blow on the part, and that from that time there had existed a very slight partial induration, productive neither of pain nor of anxiety. It seems not to have interfered with active exertion, of which W. C. had not been sparing as a zealous travelling naturalist. The enlargement of the testicle soon became considerable, and was accompanied by hydrocele. It was attended with great derangement of health, weakness of stomach, distressing pain and great emaciation. No doubt was entertained that the disease was malignant. The disease in the testicle advanced; and a tumour formed in the right iliac fossa and several in the abdomen, producing large and nodulous masses.

*Examination of the body.*—The abdomen was greatly distended, and the scrotum was about the size of the head of a child of eight or nine years of age. The viscera of the abdomen were displaced by large tumours projecting from the sides of the spines, and extending from the diaphragm to the pelvis. The liver was pushed upwards; and the duodenum remarkably put to the stretch, both in length and in diameter, its size more than equalling that of the wrist of the subject. The biliary ducts were stretched to the length of seven or eight inches, and were also enlarged. Notwithstanding this derangement of situation, the texture of the organs remained healthy. The lining membrane of the stomach was neither thickened nor softened.

Though the enormous masses of tumours presented evidence of the cystiform structure, it was much less distinct than is generally the case, which may be ascribed to the length of time which they had existed. For the most part they exhibited the pale or nearly white colour commonly met with in cerebriform tumours. Some spots were coloured with blood; but other portions were of an ochre yellow colour, similar to that of an old apoplectic clot, an appearance not uncommon in fungoid tumours of very long standing. One of the largest tumours was in the right inguinal region, and was perhaps more immediately connected with

the disease of the testicle. It was of a deeper colour than the other tumours from the presence of venous blood in the membranous cysts, and also in their broken-down contents.

There was some sanguinolent serum in the tunica vaginalis; but the chief cause of distention of the scrotum, was the mass of cerebriform and fungoid tumours developed in the right testis or epididymis, leaving only a small and displaced portion of the structure of the organ discoverable.

No cerebriform matter was found in the thoracic duct.

*Case* IV.—A man of about 32 years of age, who had habitually enjoyed good health, excited the jealousy of his neighbour, who assailed him with a heavy poker, and inflicted a severe blow over the lumbar vertebræ. This caused violent pain at the time; but when this immediate suffering had subsided, no further inconvenience was experienced until about three years had elapsed, when he was attacked with occasional sharp pain in the loins, shooting down to the bladder and testes, of which the right was most affected. The urine was scanty, high-coloured, and loaded with mucus. It was passed frequently, and with pain in the bladder, testes and glans penis. There was occasional remission of these symptoms; but the means employed had but little effect, except that a belladonna poultice somewhat assuaged the pain in the testes. In about a month the pain down the thighs became excruciating. The presence of a calculus was suspected; but on sounding the patient, nothing of the kind was discovered. A caustic issue was formed in the right loin; in a few days the pains ceased, and the patient could jump about without suffering. The relief was only transient, the pain soon returned; but nearly quitting the testes and thighs, became extremely severe in the loins and the whole abdomen, in which a firm nodulous tumour was distinctly felt projecting from the spine. It appeared to be attached to the anterior part of the lumbar vertebræ, chiefly on the right side. The patient's general health suffered considerably. He ema-

ciated rapidly, and sunk between three or four months from the time of his seeking medical assistance.

On *examination after death*, all the viscera, including the kidneys, appeared to be healthy; but a nodulous fungoid or medullary tumour projected forward from the lumbar vertebræ, below the kidneys. It appeared to be attached to the ligamentous structure covering the vertebræ, and pressed upon the lumbar and spermatic nerves. The psoas muscles were also implicated in the disease. Some parts of the tumour, which was described as medullary sarcoma, were breaking down and softening internally.

*Case* V.—W. C., a gentleman of between 40 and 50 years of age, actively engaged in business, and of regular habits, intending to take his seat in a chair, which a short time previously he had observed to be placed behind him, but which in the interval had been removed, came with violence to the floor. The shock which he received produced but little immediate inconvenience, and did not interfere with his attention to the affairs of his business and family; but in the course of a few months a remarkable loss of flesh was observed to take place. His meals were followed by pain and inconvenience; and the food often returned with much mucus. These symptoms persisted and increased, receiving but transient and imperfect relief from any of the means which were employed. A gradual change took place in the form of the patient's back, which, at first, seemed to be merely curved forward as the result of stooping from pain and debility; but afterwards it became evident that a little above the middle of the dorsal vertebræ the change of direction was more abrupt, so as to produce an angular projection. A small swelling was next observed on each side of the spinous processes, which continued to increase till the patient's death, when they formed a flattened tumour of a rounded figure of about five inches in diameter. In the epigastric region, to the left of the situation of the pylorus, a resistent tumour was detected, which gradually increased in size.

The sufferings of the patient were very great; but it is

needless here particularly to describe them, as they were the necessary concomitants of organic disease of the stomach and spine.

*Examination after death.*—The bodies of two of the vertebræ were nearly destroyed. The spinal canal was much encroached upon, and considerable masses of fungoid growth protruded from the spinal column, both before and behind. A fungoid tumour, as large as a moderate-sized apple, was situated in the parietes of the stomach towards the pylorus, but not implicating it. Numerous tubercles of similar growth were situated beneath the peritoneum, investing neighbouring parts. A remarkable fact was noticed in the mode of extension of the disease to the parts not contiguous to the primary affection. It was making its appearance in numerous parts of the osseous system, but confining itself to those situations which were in the immediate vicinity of another structure attached to the bone, as in the bodies of the vertebræ, within an eighth or a tenth of an inch of the intervertebral substance, in the transverse processes almost in contact with the cartilages of their articulating surfaces, and in the anterior extremities of the ribs all but in contact with their cartilages. In this situation the incipient disease showed itself in the form of minute cysts, varying in size from that of mignionette-seed to that of hemp-seed. They contained a translucent material of a soft, somewhat colloid consistence, and in some instances of a sanguinolent colour.

*Remarks.*—We have here two groups of cases essentially differing in their character, yet agreeing in this single particular, that they originated in local injury, inflicted a more or less considerable time before death, yet so obscurely emanating from it that in some instances the connection was only discovered on post-mortem examination. It will perhaps be admitted that such cases are not without interest, as serving to suggest inquiries as to the exciting causes, when cases of anomaly and doubt are brought under our notice. Yet it is not so much on this account that I have been induced to bring them

forward, as to offer—which I do with considerable diffidence —some speculations as to the train of symptoms and the nature of the molecular changes induced.

I shall commence by soliciting attention to the *first group* of detailed cases.

In all the instances related, the immediate effects of the local injury were so transient, that, in the minds both of the patients and of those about them, they were not connected with the fatal symptoms which ensued. After the lapse of a few weeks, some exposure to cold was referred to as inducing febrile disturbance, which, instead of yielding to the ordinary means, became exceedingly severe, and proceeded, with various and anomalous symptoms, to a fatal termination.

In two of the cases, the head and intellectual faculties were materially disturbed; and although, in the third case, neither delirium nor loss of consciousness was noticed until the patient was actually moribund, yet I am inclined to believe, from the settled presentiment of death, and from other peculiarities since remembered, but scarcely noticed at the time, that the mind in this case also was somewhat affected. The constitutional disturbance was such as to excite the suspicion that the brain, the heart, or some important part of the alimentary canal, was in a state of acute inflammation; and, in two of the cases, the severity and rapidity of the symptoms were nearly as great as in cases of dissection and other poisoned wounds.

It becomes a subject of inquiry how this great disturbance is excited, seeing that it may be ascribed either to the production of a morbid poison in the system itself, or to the mechanical irritation of the nervous system by continued and unremitted pressure or distention. The latter opinion may receive some support from the relief afforded by deep incisions in somewhat analogous cases, from the transient relief obtained in the case of W. F. from the application of leeches, which could merely unload some of the smaller vessels in the vicinity, and from the similar relief afforded by taking blood from the arm, which diminished the force of

the arterial current to the affected part. The mitigation of suffering was so short as clearly to indicate that it could only depend on the temporary diminution of tension, whilst the depletion itself was rather injurious than beneficial. I am, however, inclined to give preference to the other supposition, of a morbid poison being generated in the system, analogous to that which operates in dissection-wounds, puerperal fever, cynanche maligna, and the inflammation of the aggregate glands of the ileum, when associated with the most severe and rapid typhoid symptoms. The production of small vesicles, containing puriform fluid, scattered over the surface of the body, and resembling ecthyma, but without the reddened areola, seems to give some support to the idea of a poison. I have noticed the same symptom in other cases of purulent deposit. But it may be said, how is this idea consistent with the fact of the patient going about for so long a period after the accident, without inconvenience, and in apparent health? My reply to this interesting question is, as I readily admit, purely speculative.

It seems to me that the immediate effect of the local injury is so to impair a portion of the animal tissue as to render it incapable of the proper maintainance of those molecular changes by which interstitial absorption and deposition are carried on; in fact, that the part thus damaged is very much in the state in which a portion of bone exists when it is about to become necrosed from injury. The changes which take place in dead animal matter proceed in the injured part very slowly, on account of its being protected against those agents by which such changes are usually promoted; and, in healthy persons, neither in the constitution nor in the tissues immediately surrounding the injured part, is perceptible inconvenience or derangement set up. The same is sometimes the case when a purely foreign body is so lodged. During the existence of this state of things, another exciting cause may come into operation, such as the exposure to cold in the first two cases; and the exposure to cold, and abortion, in the third. In the febrile state produced

by these causes the surrounding structures are no longer able to resist the morbid influence of the previously-injured part, in which chemical changes have been progressively going forward. So modified, it becomes a source of irritation to the parts in contact with it, and the result is common inflammation, or derangement of a more specific kind, modified by the poisonous character of the offending cause, and by the further production of a like cause in the system. When we consider the almost endless variety of principles which the elements of the animal tissues may form by slight differences in their proportions and modes of combination—a fact shown both in health and in disease; in the one case, in the varieties of the tissues; and, in the other, in the numerous kinds of morbid virus—there seems nothing forced or improbable in this supposition of the production of a morbid poison. Yet it may be asked, what are the reasons for even hypothetically supposing anything beyond ordinary inflammation? The rapid progress, the cerebral disturbance, and the remarkable constitutional depression, suggest a similarity to those diseases in which the existence of a morbid virus is supposed to operate. The altered condition of the blood, which, in the cases related, imperfectly coagulated or favoured passive hæmorrhage; the production of vesicles filled with puriform fluid; and, in one case, the peculiar odour which was exhaled,—seem to indicate the operation of a cause acting like a leaven in the system.

The very remarkable odour of malt, or saccharine matter, observed in the case of M. R., appears to be sufficiently interesting to merit a little attention—the more so, as I do not remember to have heard or read any notice of this symptom, although I have repeatedly met with it. Hitherto, I have only noticed it in cases which have proved fatal, and I almost regard it as a certain omen of death. At first I suspected that it might depend on a peculiarity of the system, dependent on the abortion which had taken place. This suspicion was rather strengthened by my next observing it in the following case, in which pregnancy was also prema-

turely and fatally interrupted. I should not here adduce it in detail, merely to illustrate the symptom now under consideration; but, as an independent case, it seems sufficiently interesting to merit being placed on record.

M. Rivett, a patient of E. Vincent's of Stratford, who was supposed to be in the fourth month of pregnancy, on turning herself in bed, felt a sudden pain in the lower part of the abdomen, suggesting to her mind the idea that something had given way. She had before occasionally felt pain in the same part. The pain now persisted, though internal and external means were employed to obtain relief. The stomach rejected almost everything which was swallowed, and the bowels were constipated; but this latter difficulty was progressively overcome by medicine and enemata. The abdomen became distended and tympanitic; the pulse quick and almost imperceptible; in fact, she appeared moribund. Small doses of calomel and opium were now ordered every two hours, with warm fomentations to the abdomen, followed by turpentine liniment. The smallest quantities of water, beef-tea, and egg and brandy or soda-water, were supplied at stated intervals only, whilst the warmth at the extremities was to be carefully supported. A mercurial liniment was applied, and a poppy or opium enema was administered. The next day there was some visible improvement. The temperature of the body was maintained; the pulse full and soft, and the abdomen much less distended; but the head was a little affected. A larger dose of calomel was given, and some hours afterwards the calomel and opium were resumed. Opium enemata were likewise given, and the bowels becoming relaxed, chalk, opium and starch were on different occasions employed. About this time the urine was retained, and a considerable quantity drawn off with the catheter. But this difficulty did not afterwards recur. The tympanitic distention had nearly or quite disappeared, and some hardness being felt about the right iliac inguinal region, a few leeches were applied. The calomel and opium were suspended, al-

though no affection of the mouth had been perceived. Sickness had ceased, and small quantities of beef-tea, rice, gruel and jelly were taken. The irritability of the bowels had so far subsided, that a gentle rhubarb aperient appeared needful, and acted favourably. The patient craved small quantities of meat, had a greatly improved appearance, was cheerful, and seemed so decidedly better in every respect, that further consultation was deferred. This improvement had persisted for nearly three days. The patient, however, not only ventured on the increased diet before mentioned; but, without permission, took a small quantity of porter and green vegetables, and underwent a more thorough arrangement of her person, including washing and change of garments. Whether any of these circumstances are to be regarded as a cause or not, a sudden relapse took place. The mouth and throat became extremely sore, but without the slightest mercurial fœtor; the breath, on the contrary, had rather a saccharine odour (the peculiar sweet smell already alluded to). The bowels were extremely irritable, and small loose bilious evacuations were frequently passed, apparently without mucus. There was so much hæmorrhoidal swelling and tenderness, that the patient could not bear enemata. There was no return of abdominal distention. A small defined resisting body was felt above the pubic region, and was supposed to be the gravid uterus. It had been noticed, as a cause for encouragement, that no threatening of abortion had been apparent. The means resorted for the relief of sickness and tenesmus proved unavailing, and the patient sunk about fourteen days from the time at which rupture of the uterus is supposed to have taken place.

The abdomen only was examined by E. Vincent and his assistant in the presence of myself.

There was little or no effusion into the peritoneum; but the peritoneal surface, the parietes and viscera were of a dark, nearly black, colour, intermixed with shades of livid red, suggesting the idea of intense inflammation with exudation of blood, rather than of a general hæmorrhagic effu-

sion into the cavity of the abdomen. There was some slight recent adhesion between the parietes and viscera. A soft flaccid fœtus of about four months, which had evidently been long dead, was found amongst the obscured viscera in the hypogastric region. A large firm coagulum of blood was found in the situation in which the gravid uterus was to be sought, and was removed in conjunction with the uterus. It then appeared that the uterus had ruptured at the back part, where it was extremely thin. The coagulum extended to the interior of the uterus, though the larger part was external to it; and it was not easy to account for its collection into a defined mass in the hypogastric region, unless the membranes of the fœtus had contributed to retain it. The uterus had nearly resumed the size and structure of the unimpregnated state.

The viscera, so far as they were examined, exhibited no other appearance of disease than that which was connected with the severe peritoneal inflammation before noticed.

I have distinctly perceived the same saccharine odour in a third case, in which the lady died a few days after premature confinement. But my suspicion of its necessary connection with pregnancy was wholly removed by my meeting with it, in the most remarkable degree, in a lad who died of mesenteric disease, with great irritation of the bowels. The breath exhaled the odour of malt or caromel for many days before death, and the urine smelt like sweet-wort, yet little or no trace of sugar was obtained from it by evaporation. I have perceived the same symptom in an aged patient whose death was caused by a recent attack of apoplexy.

Before I proceed to the consideration of the second group of cases of local injury, a few further short observations regarding the first group seem to be called for. It may be said, in what respect do these cases claim to be distinguished from cases of local injury of every-day occurrence? If they merit to be regarded as peculiar, why are they not more common? And if they are admitted to be both peculiar and rare, what

practical conclusion is to be drawn from them with reference to treatment?

With regard to the first point, I conceive that in ordinary cases of local injury, if not sufficiently severe to cause speedy death, some degree of local inflammation is immediately set up. This either terminates in resolution, and allows the injured part more or less to resume its former state, or, if the inflammation be more severe, produces a boundary between the injured structure and the surrounding parts, and leads to speedy suppuration, an abscess being formed which may be discharged spontaneously, or by artificial means. But instead of this, in the cases of the kind here adduced, none of these processes immediately ensues. Recovery of the injured part does not take place, and no adequate effort is made to separate the neighbouring structures from it. Whether at a later period, when an influence is exerted, common inflammation only is set up, or whether the symptoms are throughout the result of the influence of some morbid poison, I will not attempt to decide.

The rarity of these cases may depend on their occurrence requiring the combination of several peculiar circumstances: a certain amount of injury, neither too great nor too slight; some peculiar insusceptibility in the surrounding parts, and the subsequent application of a further and more general exciting cause preparing the system for the changes which take place at the time when the case comes under medical attendance.

It is not improbable that cases of this kind take place, and are almost unavoidably overlooked, from the difficulty, or even the impossibility, of discovering, after the death of the patient, that any local injury had been received. I suspect that a late excellent member of our profession, my friend Dr. Bevan, may have furnished an instance of this kind.

With respect to treatment, I can have little to offer, since in all three cases the symptoms were not connected with local injury until after death; and it was only in the case of T. F. that it was suspected before the examination of the body.

The phenomena presented by the *second group* of cases appear to me to offer a striking contrast with those to which I have adverted in connection with the first group. In the first group the vitality of the injured part appeared so reduced, that neither resolution nor process of repair took place. In the second group, on the contrary, the distinguishing phenomenon is the production of a new growth to which vital organization is essential, although this organization proves itself to be abnormal and injurious. I forbear at present offering an opinion as to the office supposed to be performed by the successive production of nucleated cells in the nutrition of old, as well as in the formation of new, parts, as there can be no question, since the researches of J. Müller, confirmed by the observations of subsequent inquirers, that such cells are present, to a large amount, in structures of the class produced in the cases in question, and probably in many other tissues. Whether the nucleated cells, produced in these cases, invariably present differences distinguishable by the eye, aided by our powerful microscopes, is still questionable; but there can be no doubt that a formative process is set up in connection with them, some of the characters of which I have already had occasion to lay before the Society in former papers. It becomes, therefore, a matter of interesting, though speculative, inquiry, how the infliction of local injury establishes this new but imperfect organization. I believe that all parts, whether old or new, can only be nourished by, or produced from, living material, and that every living cell is produced from a previous cell. If in the first group of cases the local injury was sufficient to destroy life to a small extent, in the second group, without going quite so far, it materially modified the nutrition of the parts by exerting an influence on very minute molecules. It is comparatively indifferent, as respects the present speculation, whether the newly-modified cells take their origin in such as may be proper to the injured tissue itself, or in those of the blood brought to it, for its proper nutrition; in either case the original cells are modified by the circumstances in which they

are placed. I must observe that I here employ the word *cell* as being, in the present state of our science, the recognised appellation of a peculiar class of molecules, including many varieties, from blood corpuscles to those of more irregular figure, and often of much larger size, which are met with in adventitious structures, and more especially in those of malignant character. Although many of their peculiarities have been well described, repeated and careful examination has not left me perfectly satisfied either as to their universally cellular character, or as to the extent of the operation assigned to them.

I repeat that, according to the view I am taking, it is comparatively indifferent whether the cell or corpuscle, which is to become the starting point of a new formation, be a blood disc or a corpuscle belonging to the injured tissue itself: but I conceive that in either case the important circumstance is the fact, that such molecule is modified by its being as it were incubated in a peculiar *nidus*, as the *ovulum* of a working bee may produce a queen instead of a worker, if placed in a particular part of the comb, and treated in a manner suited to produce this result. It is by no means necessary that such transformation should be immediate. A succession of transformations may intervene between the normal corpuscle and the complete production of a heterologue adventitious structure. The researches of embryologists, and more especially of Dr. Martin Barry, have demonstrated the reality and importance of the successive productions of corpuscles from corpuscles, such as are exhibited, first, in the embryon in its simplest form, and subsequently in the several textures of which its growing and superadded parts are composed. If, by these successive productions, the several tissues, such as muscle, cartilage, and the various glands, are, in the normal process, derived from the one original corpuscle which formed the starting point of the new animal, it does not seem inconsistent with probability that the corpuscles of a later generation, placed in altered circumstances, should produce a new variety of structure; and it furnishes an argument in favour of the adventitious growths in question being the result of a *degraded*

as well as *morbid* vitality, that they appear to be independent of those influences which in healthy normal structures regulate form and size, and that, in losing this control, they assume characters which they may possess not only in different tissues of the same body, but even in different species, genera and orders of animals. I have formerly given expression to the same idea, but these considerations connected with the cases brought together in the second group of this paper, seem to afford a good illustration of the principle.

When once the production of morbid corpuscles, suited to the production of a morbid tissue, has taken place, the growth of such structure at the affected part may almost be made the subject of ocular demonstration, but the subsequent appearance of a similar abnormal structure in other parts of the body is still involved in some mystery. The long period during which the disease may remain strictly local seems to indicate that in the healthy system there is some barrier to the ready transfer of the newly-formed morbid molecules to the different parts of the body; but, on the other hand, when the disease has shown itself in different parts, the striking similarity presented by the molecules taken from each of them, strongly favours the idea of family connection, and consequently of transfer.

The determination of the parts of the system in which the secondary formations are to take place is another subject of very interesting inquiry. I do not remember to have ever seen this more strikingly exhibited than in the case of W. C., in which the new growth made its appearance on the confines of the bony tissue, near its junction with cartilage. Other examples of the situation of the secondary appearance of the disease are seen when one breast is attacked after the other; also when the uterus is attacked after the breast, the pancreas after the salivary glands.

Are we to suppose that some pre-disposing cause favours the production *de novo* of the disease in each of these parts, or rather that their peculiarity consists in some power which arrests certain molecules already in the circulation, and that

so arrested, they become fresh starting points for the production of the morbid growth? I incline to the latter opinion, more particularly on account of the remarkable similarity in the microscopic characters of the morbid molecules taken from different parts of the same person.

I may perhaps here be allowed to express a doubt as to the strict propriety of distinguishing these molecules as endogenous and exogenous. I believe that they are all, strictly speaking, endogenous. I suspect that the unity, or multitude of the bright spots or nuclei, is a distinction of more practical importance.

I ventured to allude, at the commencement of these remarks, to the possibility of the function of nucleated cells in the continued nutrition and growth of some structures having been exaggerated, and I may briefly state the ground of this doubt.

In the first place, I have repeatedly sought for such corpuscles in new or growing tissues, without discovering them in any of the transformations ascribed to them. And secondly, as it is not improbable that the *liquor sanguinis* contains in solution hyaline derived from the normal corpuscles of the blood, it seems to render the intervention of other molecules for the supply of the material of growth unnecessary.

I here bring this lengthened paper to a close, after craving the indulgence of the Society, and stating, by way of apology, that having, almost from the commencement of my pathological studies, been impressed both with the difficulty and with the importance of connecting those minute molecular changes which are on the confines of visibility, or even beyond its limits, with those larger results which become the objects of demonstrable morbid anatomy, I have thought that a paper tending, however imperfectly, towards this inquiry, would not be ill-timed in the present state of our science.

# ACCOUNT

OF

# A DISLOCATION,

## IN CONSEQUENCE OF DISEASE OF THE FIRST AND SECOND CERVICAL VERTEBRÆ.

By JAMES PAGET,

ASSISTANT-SURGEON TO ST. BARTHOLOMEW'S HOSPITAL, ETC.

Received March 24th—Read April 11th, 1848.

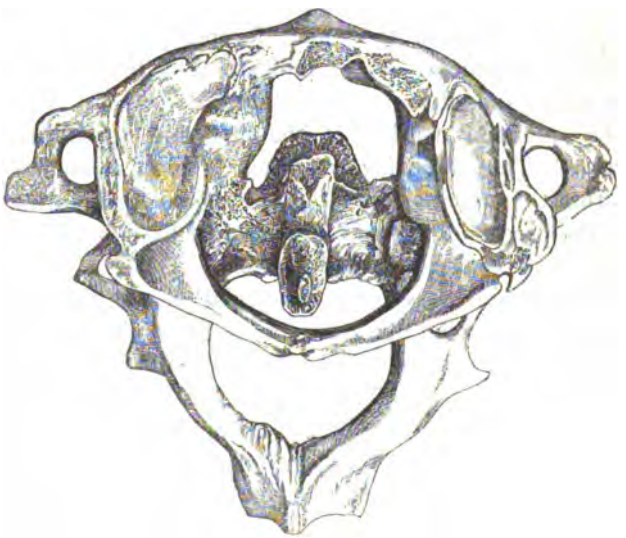
The bones which I propose to describe to the Society were presented to the Museum of St. Bartholomew's Hospital by Mr. George Banks, Assistant-Surgeon in the Naval Service, at Plymouth. He found them in a graveyard at Aberdeen, but has not been able to gain the least information respecting the person of whom they once formed part, though their texture and general aspect indicate that they were but a short time exposed to decomposition.

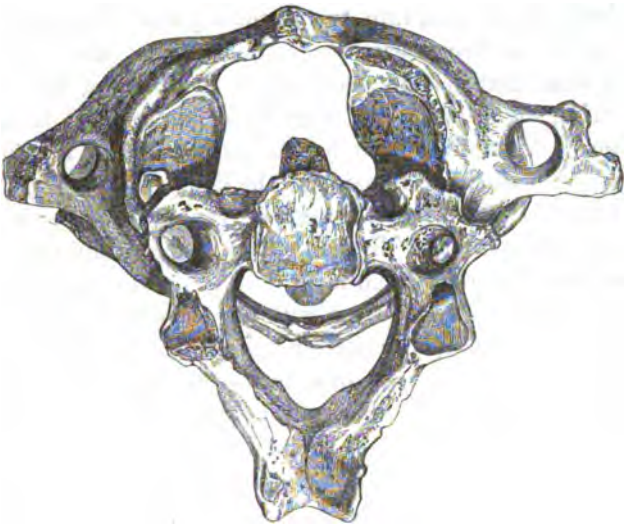
The specimen consists of the first and second cervical vertebræ of an adult, firmly united by bone, in such a position that the uppermost part of the spinal cord, during and after the process of osseous union, must have been confined within an exceedingly narrow space.

On the atlas, the surface for articulation with the odontoid process is somewhat irregular, as if from ulceration which has healed, and is surrounded with a slightly-elevated narrow border. By the sides of this surface, on both aspects of the anterior half of the ring of the atlas, numerous small perforations for blood-vessels indicate that the vascularity of the bone was increased. Both the inferior articular processes

appear to have been superficially ulcerated, and to have been healed, after the corresponding articular surfaces of the axis had been moved from them and rested on only their posterior borders. On the right side, the surface of the inferior articular process of the atlas is smooth, but has lost its naturally sharp-edged border. The surface of the left inferior articular process is cancellous, as if it had been slightly ulcerated and incompletely healed. In the centre of the posterior half of the ring of the atlas, close to its upper border, is a funnel-shaped aperture, through which it is most probable that one or more blood-vessels passed to or from the membranes of the spinal cord.

With these exceptions nothing abnormal appears in the atlas. It presents a complete ring for the transmission of the vertebral artery behind its left condyle, and one nearly complete behind the right condyle; and the depressions for the attachment of the transverse ligament are deep and strongly marked, especially on the right side, as if the ligament had retained its hold and been drawn tightly on the bone.





The axis exhibits, on the anterior surface of its body and on the inner and inferior surfaces of its arch and processes, such numerous minute foramina as characterise an increased vascularity, and which here, also, appear to indicate that these parts were covered with a thin layer of new bone, completely organised and closely united with them.

The upper part, or head, of the odontoid process appears to have been superficially ulcerated, for its whole surface is porous and rough, though hard. On the anterior and lowest part of the same process is a small growth of hard, new bone, of irregular shape and coarsely-fasciculate appearance.

The disease affecting the ligamentous connections of the vertebræ must have been more considerable than that which themselves suffered; for the axis, as if quite loosed from its natural fastenings, has been moved backwards, with a very slight deviation to the left, till its odontoid process is close to the posterior portion of the atlas. The space within the ring

of the atlas is thus divided, by the displaced odontoid process and body of the axis, into two unequal parts. The anterior part is of an irregularly quadrilateral form, and a little larger than that usually occupied by the body of the axis, measuring eight and a half lines from side to side; and, at the most, seven lines from before backwards. What filled this space, besides the remains of the ligaments passing from the odontoid process to the occiput, cannot now be determined. The posterior division of the space within the ring of the atlas, through which must have passed the upper part of the spinal cord, together with its membranes and the remains of the common posterior ligament of the spine, is of an elongated, transversely-oval form—or, rather, reniform. Its extreme width is nine and a half lines from before backwards. It measures, in the middle line—i. e. from the odontoid process to the posterior arch of the atlas—two lines; and on each side, from the body of the axis to the same posterior arch, three lines, at the most.

The vertebræ thus displaced are not diminished in size, nor materially altered in form; they are slenderly constructed, but of average dimensions.*

I need not refer to the numerous cases of dislocation, after disease, of the upper cervical vertebræ, already published, for all the most interesting of them are quoted in a paper by Mr. Lawrence in the thirteenth volume of the Transactions of this Society. Neither, while I refer to that essay, need I

* The following table shows their principal dimensions compared with those of three healthy, well-marked vertebræ.

| | Diseased vertebræ. | Healthy vertebræ. | | |
|---|---|---|---|---|
| | lines. | lines. | lines. | lines. |
| Antero-posterior diameter of the ring of the atlas | 16 | 16 | 14·5 | 15 |
| Transverse diameter of the same | 14·5 | 15 | 13·5 | 13 |
| Width between the inferior articular processes of the atlas | 8 | 8·5 | 7 | 7 |
| Antero-posterior diameter of the canal in the axis | 8 | 10·5 | 7·5 | 8·5 |
| Transverse diameter of the same | 10·5 | 13 | 11 | 11·5 |

dwell on the morbid processes which precede and attend such dislocations, or the mode in which the change of position is effected. Only, it may be remarked as a peculiar feature in the present case, that the slight appearances of disease in the atlas, and the depth of the depressions for the attachment of the transverse ligament, make it highly probable that the disease was almost limited to the surface of the articulations between the atlas and the axis; and that the transverse ligament, though diseased enough to admit of elongation, was neither destroyed nor so weakened as to allow the odontoid process to be suddenly or violently pressed upon the cord.

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## APPENDIX.

*Description of a specimen of Dislocation of the Atlas upon the Vertebra Dentata, attended with contraction and distortion of the Vertebral Canal: by* ALEXANDER SHAW, *Surgeon to the Middlesex Hospital.*

The specimen, of which there is an accompanying drawing, was exhibited at the meeting of the Society, when Mr. Paget's paper was read. The bones were removed by me, about the year 1828, from a man whose appearance was that of a common labourer or artizan, and who had been brought into the Middlesex Hospital dead, by strangers who could give no account of the accident.

On dissection, there was found to be fracture at the base of the skull, with extravasation of blood and laceration of the substance of the brain. After the examination was thought to have been completed, an unusual appearance of the opening of the vertebral canal induced me to remove the bones for further inspection.

*Description of the preparation.*—The specimen consists of

the six superior cervical vertebræ, with a portion of occipital bone,—the two upper vertebræ and the occipital bone being distorted by disease, and united by anchylosis.

Before proceeding with a more detailed description, it may be stated, 1st, that where anchylosis has taken place, the ossific matter forming the union has become perfectly dense in texture, and it has its surfaces rounded and smooth, so as to prove that the anchylosis must have been completed for a long period before the death of the patient; 2ndly, that all the bones exhibit that strong marking of the processes and eminences which give attachment to the muscles and ligaments, and that solidity of structure, which denote that the individual, shortly before death, possessed full muscular power.

The portion of occipital bone anchylosed to the atlas has its external edges ragged and irregular: that appearance is explained by the fact, that the fragment was broken off by the injury which caused the death of the patient; fissures extended round it, so as to insulate it from the rest of the base of the skull, and it could be removed without the use of the saw or chisel.*

Between the under surfaces of the occipital bone and the atlas, firm anchylosis has taken place, at different points. This union is so complete between the condyles and articular surfaces, on both sides, that the original form of the bones can no longer be recognized, owing to the closeness of the junction. On the right side, the anchylosis is continued backwards from the articular surfaces, along the inferior border of the foramen magnum of the occipital bone and the superior edge of the posterior arch of the atlas, as far as to half an inch on the left of the rudimentary spinous process of the atlas, a circular opening being left for the passage of the right vertebral artery into the cranium. The anchylosis between the occipital bone and the atlas has taken place

* This suggests the idea that the sudden death of the patient was probably occasioned by the loosened portion of occipital bone having been driven forcibly inwards upon the brain.

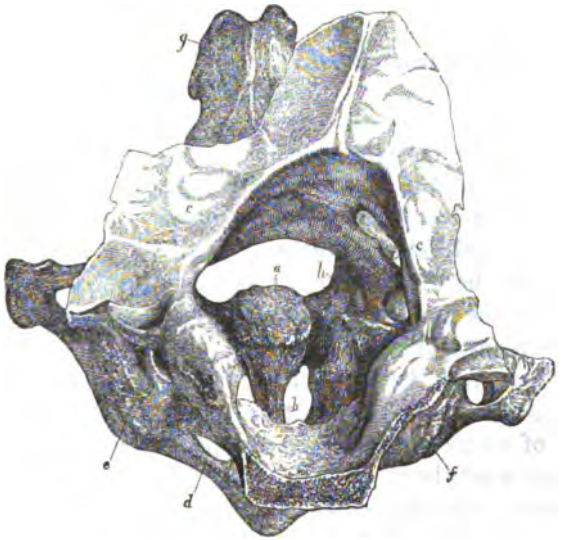
without any considerable change in the relative position of the bones; all that is perceptible being a slight shifting of the former bone to the left of the latter, causing the axis of the foramen magnum to be a little to the left of the axis of the atlas.

In describing the condition of the atlas and dentata, the principal circumstances to be attended to are the remarkable changes in the relative position of these bones to each other. For it is owing to these changes that the vertebral canal has become so much contracted and deformed.

The first thing to be observed is, that the vertebra dentata preserves its proper relation to the third vertebra of the column, and that all the irregularities about to be described have resulted from displacement of the atlas upon the dentata. 1st, The atlas has been carried forwards upon the dentata, so as to be advanced beyond its proper level in relation to that bone. But this advancement is much greater on the left side than on the right: for while the left articulating process has been moved forwards about three quarters of an inch, and a buttress of bone has been thrown out in front of the dentata, to support it in its overhanging position, the right articulating process has been advanced only about a third of an inch. 2ndly, Instead of the atlas having been carried forwards on a horizontal plane, there has been an inclination to the left side, so that the whole bone dips to that side. 3rdly, At the same time that the atlas inclines to the left, it has been shifted in its position to that side, so as to overhang the dentata on the left, as it overhangs it in front. 4thly, Owing to the atlas having been carried forwards on the dentata, the part corresponding to the body of the atlas has been separated about half an inch from the processus dentatus, with which it had been originally in apposition; the space between the articulating surfaces has been filled by a new growth of bone a quarter of an inch thick and half an inch deep, which passes as a beam from one point to the other, so as to give additional support to the displaced atlas. 5thly, From inspecting the preparation and

observing the general direction of the displacements, it cannot be doubted that the disease, which was the original cause of the changes, was seated principally in the left articulating processes of the atlas and dentata. It confirms this view, that whereas there is firm anchylosis of these surfaces, there is no union, and very little appearance of previous disease, in the right articulating surfaces. All that can be observed, in the right articulating process of the atlas, is, that, besides being carried forwards on the dentata about a third of an inch, as stated before, it has been brought close to the processus dentatus, by the general shifting of the bone to the left side.

Lastly, let me direct attention to the changes produced in the relation of the axes of the two bones, by their altered position. The principal change of this kind has resulted from the displacement forwards of the atlas: for owing to this bone having been carried forwards while the dentata remained in its place, the centre of the circle which the atlas represents has been advanced in front of the centre of the circle which the dentata represents. According to the most correct measurement I can make, it appears that the central point of that part of the atlas which enters into the formation of the spinal canal is situated in a line half an inch before the axis of the spinal foramen of the dentata: and the effect of that change is seen by the posterior arch of the atlas crossing the spinal foramen of the dentata and intersecting it about equally. Another point to be remarked is, that, owing to the atlas having been moved towards the left side, as well as carried forwards on the dentata, its axis, instead of being placed straight in front, is directed a little to the left of that of the dentata. Consequently, there must have been encroachment on the space within the vertebral canal for containing the spinal marrow at each side, as well as in front and behind.




*Description of the Wood-cut.*

The view represented in the drawing is that obtained by holding the preparation to the level of the eye, and looking down the vertebral canal through the foramen magnum.

*a.* Processus dentatus of the vertebra dentata.

*b.* Plate of bone which passes from the articulating surface of the processus dentatus to that on the anterior arch of the atlas.

*c c.* Posterior arch of the atlas, joined by anchylosis, on its left side and centre, to the inferior border of the foramen magnum.

*d.* Part of the anterior arch of the atlas near the tubercle.

*e.* Rough surface marking the line of union by anchylosis between the right condyle of the occipital bone and the corresponding superior articular surface of the atlas.

*f.* Anchylosis of the same named parts on the left side.

*g.* Spinous process of the vertebra dentata.

*h.* Left pedicle of the vertebra dentata.

*Some measurements of the superior opening of the vertebral canal.*

Greatest distance between the posterior surface of the processus dentatus and the inner margin of the posterior arch of the atlas, (being the antero-posterior diameter of the vertebral canal)—three-tenths of an inch.

Distance between the right pedicle of the atlas and left pedicle of the dentata, (being the transverse diameter of the canal)—nine-tenths of an inch.

Distance from the inner border of the foramen magnum on the right side to the centre of the processus dentatus,—four-tenths of an inch: from the corresponding points on the left side,—nine-tenths of an inch.

Distance from the posterior surface of the processus dentatus to the centre of the anterior border of the foramen magnum,—five-tenths of an inch.

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*Postscript, Aug.* 1848.—I have at present under my care, in the Middlesex Hospital, a girl æt. 15, who has disease of the two superior cervical vertebræ; and in whom there is every reason to suppose that the atlas has become displaced upon the dentata, in the same manner and to as great an extent as in the preparation above described. The most marked peculiarity in the girl's appearance is, that the head is placed too far forwards in relation to the axis of the neck; so that the greatest projection of the occiput is in a line more in front than the projection caused by the spinous process of the dentata, and the chin and face are proportionately carried forwards as compared with the neck. By pressing with the point of the finger above the spinous pro-

cess of the dentata, a deep hollow can be felt, caused, apparently, by the atlas and occipital bone having been moved forwards, (probably by the weight of the head,) beyond their proper relation to the dentata. The head also leans obliquely to the left side, as must have been the case with the man from whom the preparation was taken.

The patient first came under my observation in the end of March of this year, when the distortion of the neck was about the same as at present. She had suffered pain in the crown of the head, but not much in the neck, for about four months (the origin of the pain being attributed to influenza). At one time she was affected slightly with incontinence of urine, and had some pain in her legs; but she did not give up work as a domestic servant till three weeks before she applied at the hospital. Her chief complaint was then stiffness of the neck; she had also pains in both shoulders and arms; but there were no indications of paralysis in any part of the body. To give her the advantage of rest in the recumbent position, and counter-irritants to the neck, and to provide her with supports for the head, she was kept in the hospital till the middle of May. Early in June she was readmitted. She stated that soon after being discharged she had weakness in her legs, which prevented her from standing or walking; but as she lay on her back she had perfect power over her limbs; she had neither numbness nor spasms in the legs; occasionally she had incontinence of urine. Having been kept quiet for some weeks, without any symptoms of paralysis manifesting themselves, she was allowed to get out of bed and take moderate exercise. For some time back, wearing the supports to her head, she has sat up at her needle, and assisted the nurse in the light work of the ward; and arrangements are now being made to send her to the sea-side.

A cast showing the distortion is preserved in the Museum of the Middlesex Hospital School.

ON

# THE MINUTE ANATOMY

OF

# THE EMPHYSEMATOUS LUNG.

By GEORGE RAINEY, M.R.C.S.,

DEMONSTRATOR OF ANATOMY AT ST. THOMAS'S HOSPITAL.

Communicated by Dr. TODD.

Received May 31st—Read June 27th, 1848.

The form of emphysema which furnishes the subject of the following details is that which is called "Vesicular Emphysema," and the specimens of this disease, which have been selected for minute examination, are of the ordinary kind.

The subject from which the greater part of the preparations illustrating the facts described in this essay, and from which the drawings accompanying it were taken, was about forty years of age, and the general aspect of his lungs, especially in the vicinity of the emphysematous part, was healthy. There were, however, in some parts of the lung, a few small tubercular deposits.

Before the abnormal condition of the structures entering into the composition of the lungs, as they appear in emphysema, is described, a few observations on the normal state of these parts may advantageously be premised; and, the air-cells being the seat of this disease, these observations will be confined to them.

The only two structures entering into the composition of

the air-cells, distinguishable by the microscope, are capillary vessels, and the membrane by which they are invested and connected together. The capillaries are known by the minute oval spots on their coat, generally considered to be the nuclei of cells, as well as by the extremely faint outline of the coat itself. In the uninjected subject this coat can with great difficulty be distinguished, especially when the capillaries have no blood in them; but in the injected lung it is sufficiently evident in those vessels which contain only a small quantity of injection. Nerves are not recognizable in the air-cells, although it can scarcely be imagined that no nerves exist in these parts.

If a portion of injected lung, magnified twenty or thirty diameters, be viewed by reflected light, it is seen to be made up almost entirely of irregularly-shapen cavities—the air-cells—differing very much both in size and form, but for the most part cuboidal. The dimensions of the air-cells differ greatly in different parts of the same lung, being the largest in those parts the most remote from its centre. They are frequently so large at the margins and extremities of the lobes, that these parts of a lung, retaining a good deal of air after death, are sometimes considered to be emphysematous when they are perfectly healthy. The walls of these cavities appear by reflected light to be formed entirely of a dense plexus of capillaries, consisting only of one layer of these vessels, which is so situated with respect to contiguous air-cells that the same layer forms a part of the two cells between which it is situated, one side of it bounding one of these air-cells, and the other side the adjacent one.* The air-cells communicate by large circular openings through which the air can pass freely from one into another. An indefinite number of these air-cells, surrounded by areolar tissue, and supplied by a branch of the pulmonary vessels, constitutes a lobule. The larger branches of the pulmonary artery and vein run in the intervals between the lobules, while the smaller ramifications run between the air-cells themselves, and send off

* See Plate IV. fig. 1.

branches in different directions to the nearest plexuses, in which they anastomose very freely with the radicals of the pulmonary veins, and also with the ultimate ramifications of the neighbouring pulmonary arteries.

The membrane connecting the capillary plexuses—"pulmonary membrane"—is very thin, almost transparent, and made up chiefly of an irregular interlacement of extremely delicate fibres, which are most distinct around the openings of communication between the air-cells, where they appear to be somewhat circular. This membrane, whilst in a healthy state, is devoid of any regularly-formed corpuscles; the appearance of minute cellules may occasionally be observed in some parts of it, but these are so very rare, their form and size so irregular, and their situation so uncertain, that they cannot be regarded as an essential part of its structure, and may therefore be considered either as accidental or abnormal. The pulmonary membrane lines the air-cells, and in passing from one cell into another encloses the plexuses of capillary vessels between the two cells: hence between each two contiguous air-cells there is one layer of vessels and two layers of membrane. This membrane has no regular covering of epithelium, the ciliated form of epithelium ceasing with the bronchial membrane, which extends no further than the termination of a bronchial tube in a bronchial inter-cellular passage.*

The office of the pulmonary membrane is to connect and support the capillary plexuses, and to form the immediate boundary of the air-cells. It appears to be the seat of disease in emphysema, as hereafter will be shown.

Having premised these observations on the minute structure of the air-cells, it will be more easy to render intelligible the changes which they undergo in the disease now under consideration.

If a very thin section, or even a mere fragment of emphysematous lung, especially if it had first been minutely injected, be examined by a lens of one-quarter inch focus, by transmitted light, the pulmonary membrane will be seen

* See Medico-Chirurgical Transactions, vol. xxviii. p. 581.

to be perforated, or cribriform. The perforations in this membrane are generally well defined, of an oval or circular form, of various sizes, and more or less numerous, according to the progress of the disease.* In very thin sections of lungs in other respects normal, I have occasionally met with an opening or two through this membrane, corresponding to the areolæ of the plexuses, but these are so few, and their existence so uncertain, that they may probably be regarded as accidental, or perhaps in some cases the result of incipient disease, as I have not found them in lungs which I have known to be perfectly healthy, and which I have examined expressly for the purpose of determining the normal state of the pulmonary membrane. These openings cannot be confounded with those by which the air-cells open one into another, or by which the air-cells open into the intercellular passages, the latter being surrounded by a circle of anastomosing vessels. The next point to be noticed is that the pulmonary membrane in the vicinity of these perforations, as well as in many parts not yet cribriform, is studded with brightish spots, generally of a circular form, which vary in number and size, but in many instances are about the magnitude of the nuclei observable in the coats of the capillary vessels, and might possibly be mistaken for them, did they not occur in situations where there are no such vessels, as in the areolæ of the plexuses.† These spots exist either singly or in clusters, and I have no doubt precede the formation of the perforations above observed, the latter having the form and occupying the same parts of the membrane as the former. The size also of the perforations accords with the size of the spots, being either that of an individual one or of several aggregated together. This appearance, by a careful examination, is seen to be due to the presence of oil in the tissue of the membrane, or upon its surface. In some parts the oil appears to be so intimately blended with the substance of the membrane as only to increase its transparency, and thus to produce the appearance of bright circular

* See Plate IV. fig. 2. † See Plate IV. fig. 3.

Fig. 2.

Fig. 4.

Fig. 1.

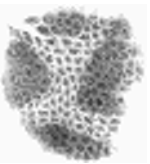
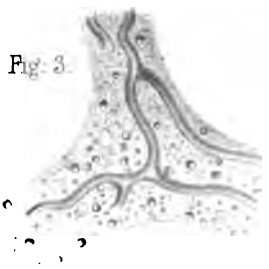


Fig. 3.



B.George,del.et lith 54 Hatton Garden

spots; in others, where it is less intimately blended with the tissue of the membrane, it exists in the form of numerous minute globules, and of others of larger size, apparently due to the coalescence of these. This latter form presented by the oil occurs chiefly in those parts where the pulmonary membrane is thickest. If now a very small portion of the membrane thus affected be dried, then pressed between two pieces of glass, and gently heated, small particles of oil will be left upon the glass, distinctly visible by the microscope; or if it be digested in sulphuric æther, all the minute globules before discernible upon it will have disappeared. From these facts it seems obvious that, owing to a change induced by some cause or other in the nutrition of the pulmonary membrane, the materials of which it is composed pass into a different state of combination, and are converted into oil, and that in consequence of this change the texture of this membrane in the part of the lung affected is in some places weakened, and in others wholly destroyed;—a condition which cannot fail so to impair the mechanical function of the membrane, as to render it incapable of supporting the capillary plexuses, and of furnishing that resistance to the pressure of the air contained in the air-cells which is necessary for maintaining the several parts of the lung in their proper situation; and a condition, therefore, sufficient to account for those changes in the form and size of the air-cells, and their subsequent breaking up, which constitute the more obvious derangements in the structure in the lungs in emphysema next to be described.

The pathological appearances now to be noticed are those observable in the disposition and condition of the blood-vessels. To determine the abnormal state of these parts satisfactorily, and to its fullest extent, the vessels of an emphysematous lung must have been injected prior to examination.

If those parts of an injected emphysematous lung, in which the air-cells are merely dilated, be examined by reflected light, the capillaries in their walls are seen to be smaller than

natural, whilst the spaces circumscribed by their meshes are much increased in size.* These changes in the vessels are proportional to the extent of the dilatation in the air-cells. They seem to indicate that the membrane, previously to its giving way, had been in a state of great extension. This extension may have arisen either from an undue pressure of the air in the air-cells upon the membrane, in consequence of some impediment to its free passage from the lungs, the membrane being in a perfectly healthy state; or from the pressure of the air in ordinary respiration, the membrane being weakened, and rendered more yielding than natural by some disease. In the case under consideration, I am not aware that there was any impediment to the respiration which can account for the changes which existed in the membrane and vessels of the lungs; whilst there seems to be sufficient cause for the elongated and attenuated state of these parts, in the process of fatty degeneration going on in the membrane, whose function it is to preserve all parts of the lung in their proper situation. I believe, therefore, that the dilatation of the air-cells and the changes in the capillary network were produced by the extension of their walls, which being weakened, as before described, have yielded under the pressure of the air within them, and caused the vessels to become elongated, their calibre diminished, and the areolæ of the plexuses to be enlarged. In parts where a visible lesion of the membrane between the air-cells has taken place, and several cells have become united so as to form one cavity, fragments of cell-walls are seen within it, containing extremely elongated capillaries and portions of plexuses, in which the vessels are very much contracted, and the areolæ enlarged but mostly in length.

The extremely attenuated state of the vessels, prior to their division, seen in the injected emphysematous lung, is worthy of notice, as this state, together, perhaps, with a certain degree of retraction of their coats at the instant the division takes place, may be regarded as the reason that

* See Plate IV. fig. 4.

hæmorrhage never occurs in emphysema of the lungs. After the disease has advanced still further, and the emphysematous cavity become large, and situated near to the pleura, all vestiges of the air-cells which were broken up to form it have in a great measure disappeared, and its sides are then held together by fibrous bands of various degrees of strength extending across it. These bands are the remains of the inter-lobular tissue, and they, like the pulmonary membrane, after sustaining a certain amount of elongation, give way. Their broken ends are distinguishable in these cavities in the form of irregular nodulated masses, produced by the retraction of the chords after their rupture.

The inter-lobular cellular tissue being gradually condensed during its elongation, becomes more compact and less capable of inflation; consequently the rupture of the bands into which it had been drawn out is not followed by extravasation of air between the lobules, and the occurrence of inter-lobular emphysema. When the emphysematous cavity has arrived close to the pleura, being separated from it only by the external wall of the most superficial cells, with the sub-pleural vessels and areolar tissue, the pleura in this part becomes thickened, and the sub-pleural vessels very much developed, though without exhibiting the appearance of injected vessels going to an inflamed part. These changes in the structure of the pleura and sub-serous cellular tissue are rendered necessary to support the pressure of the air, to which they are now exposed in consequence of the destruction of the air-cells lying immediately above them.

A review of the facts above stated seems to prove that the form of emphysema here described originates in a morbid process going on in the pulmonary membrane, by which the elementary substances entering into its composition are made to pass into that state of combination which is necessary to form oil—a process very common in other structures and organs of the body, and which of late years has been described under the title of "Fatty degeneration."

## EXPLANATION OF PLATE IV.

Fig. 1. Exhibits a portion of healthy lung injected, to show the dense plexuses of vessels situated around the air-cells, and the minuteness of their meshes in relation to the capillaries enclosing them.

Fig. 2. Exhibits a portion of emphysematous lung, in which the membrane connecting the vessels, the pulmonary membrane, is perforated by numerous foramina, and also studded with minute bright spots, occurring, some in clusters, others singly.

Fig. 3. Exhibits another portion of pulmonary membrane, rather thicker than the former, from the same lung, in which, in addition to the parts above noticed, a multitude of oil-globules of various sizes is seen.

Fig. 4. Exhibits a portion of emphysematous lung injected, to show the elongated and contracted state of the vessels, the enlargement of the meshes of the plexuses, especially in the direction in which the parts appear to have been stretched, and cavities produced by the breaking up of the walls of the cells.

ON THE

# UTILITY OF TRISNITRATE OF BISMUTH,

IN THE

## DIARRHŒA ACCOMPANYING PHTHISIS.

By THEOPHILUS THOMPSON, M.D., F.R.S.,

PHYSICIAN TO THE HOSPITAL FOR CONSUMPTION AND DISEASES OF THE CHEST.

Received June 1st—Read June 27th, 1848.

Among the complications of pulmonary consumption, diarrhœa is one of the most frequent and distressing, materially aggravating the sufferings and accelerating the fatal issue of that disease; and as there is no reason to ascribe to it any compensating advantages, its mitigation or cure is in all cases desirable. The ordinary modes of treatment are, however, by no means satisfactory, milder measures often failing to relieve, and the more active ones to subdue, the disorder. And, even when the diarrhœa yields to their use, the inconveniences of an opposite condition may be induced, or, as in the case of the most powerful of these remedies—acetate of lead—still greater evils may ensue. It is therefore with great satisfaction that I have to record the effects of a remedy which, for the last twelve months, I have been accustomed to employ, without in any one instance observing the least inconvenience from its use. That remedy is the trisnitrate of bismuth. I have preserved notes of twenty-one of the cases in which it was given. Of these, eighteen were phthisis in various stages of progress, and three were bronchitis. In fifteen of the patients, the diarrhœa was entirely removed. In four, transient benefit was experienced; and the remedy

proved useless only in two instances. In one of the cases in which the bismuth failed, the evacuations were deficient in bile. In the other—a case of phthisis in the last stage—the diarrhœa had continued for two years. In the instances wherein the relief of the symptom was only temporary, the dejections were for the most part dark and offensive. In the fifteen satisfactory cases, the duration of the diarrhœa had varied from six days to three months, and the number of daily evacuations from three to thirteen. Marked benefit was usually experienced after the second dose, and the disorder was almost invariably subdued in less than a week.

In four of the cases in which the remedy sustained its character, the strength of the patients had been rapidly sinking. In the first, the mouth was aphthous. The second patient was an infant aged one year, in whom diarrhœa had lasted for a month, and who died three weeks after this complaint was removed. The third was a child aged three years, in whom diarrhœa of some months' duration was rapidly removed by bismuth, but who died of phthisis about a fortnight afterwards. The fourth, a young woman, aged 19 years, in whose case diarrhœa of a month's duration yielded to the remedy, survived only two months. It may reasonably be presumed that in several cases there was ulceration of the bowels; but, as most of the subjects were out-patients, I was unable to verify this opinion by post-mortem examination.

I administered the remedy to adults, in doses of five grains, usually combined with three of gum-arabic and two of magnesia, and at intervals of four or six hours. Larger doses may be given with safety, and smaller might be effectual, but I consider four or five grains to be the most appropriate dose for the purpose in view.

Trisnitrate of bismuth was, I believe, first introduced about fifty years since, as a remedy in gastralgia, by Odier and De la Roche, of Geneva, who believed it to exert a sedative influence on the nerves of the stomach. The observations of these physicians were confirmed by Baumes, Meglin, Laennec, Guersent, and others, in France, and by

Gumprecht, Reil, Kopp, and Schmidtmann, in Germany; but, notwithstanding the recommendations of Bardsley and Clarke, a considerable time elapsed before its usefulness in this affection was appreciated in England.

In the year 1831 Dr. Leo of Warsaw employed bismuth as a remedy for the diarrhœa and vomiting of cholera. His representations led to its employment in various parts of the Continent, but with uncertain results. At Posen, for instance, it was alleged to be useful, but at Dantzig to have failed.

A review by Constant, in the Gazette Medicale for 1833, in which two cases of obstinate non-febrile diarrhœa in children are reported to have been successfully treated by Guersent, is the earliest detailed notice with which I am acquainted, of this property of bismuth. It did not however attract special attention, and I should probably have delayed any extensive trial of its virtues but for the opinions expressed to me on the subject by my friend, Dr. Lombard, of Geneva. His favourable experience of its use in the general treatment of relaxation of the bowels determined me to test its efficacy in the diarrhœa accompanying phthisis, and the result of my experiments is a conviction that this is the form of diarrhœa to which bismuth is especially applicable, and that, *both in efficacy and safety, it surpasses our most approved remedies* for that complaint.

By delaying this communication I might have treated the subject more minutely, determined some of the conditions qualifying the use of bismuth, and ventured on speculations respecting its mode of action; but the grounds of my favourable opinion appear sufficiently strong to urge my losing no time in recommending to my professional brethren the trial of a remedy which, if equally successful in their hands as in mine, will prove of peculiar service in a most afflictive malady.

CASE OF

# RESECTION OF THE SCAPULA.

By WILLIAM FERGUSSON,

PROFESSOR OF SURGERY IN KING'S COLLEGE, LONDON.

Received May 8th—Read June 13th, 1848.

William Hermon, æt. 33, was admitted into King's College Hospital, January 13, 1847. He had served as a soldier in various parts of the world; and had suffered from disease of the right shoulder joint for about seven years, when he was sent to Fort Pitt Hospital, where the extremity was amputated* at the articulation, and a portion of the glenoid cavity was removed at the same time. He made a good recovery from the operation and improved in health; but the wound never entirely healed. About twelve months ago an abscess formed on the front of the chest on the same side, which was attended with great swelling both in the stump and the lower part of the neck.

At present the affected shoulder is considerably larger than the other, all the soft tissues being involved in the swelling. There is a line of a cicatrix reaching from opposite the point of the acromion process to the lower and back part of the axilla, with several openings in it. Over the clavicle, on the back of the scapula, in the pectoral region in front, and in the cicatrix, there are altogether thirteen openings on the surface, eleven of which communicate with bare bone.

* By Staff-Surgeon Williamson. Vid. Medical Gazette, vol. xxxvi. 1845, p. 812.

The patient has a slight cough, but is otherwise in fair health. He is tall but spare in figure, and has the appearance of one who has long suffered from disease. There is a constant discharge from most of the openings; and, although he has no great positive pain, he feels exhausted by the continued irritation arising from the diseased state of the shoulder.

This patient was sent to me by my friend Mr. Barker, of Wantage, who entertained the opinion that nothing less than the removal of the whole scapula would suffice for a cure. At first sight I could not fancy that such a formidable proceeding was requisite; and it was only after a very careful study of the case that I came to the conclusion that such an operation was the only course which promised any hope of relief.

With the patient's concurrence I accordingly carried our views into execution, on the 6th of February 1847; and the operation was conducted thus:—Whilst he was under the influence of ether, and in a semi-recumbent position, an incision was made through the skin over the outer half of the clavicle, along this bone, as far as the acromion, and the tissues were so separated as to permit a bone spatula—the end of an ordinary paper cutter—to be passed under the clavicle about two inches from its outer extremity. This being done, the bone was divided with a saw; next, the skin was divided along the spine of the scapula from the acromion to near the base, when, with a large clasp bistoury, an incision from eight to ten inches in length was made, downwards from the acromion, in the course of the original cicatrix. The skin and some thickened tissue beneath were now raised for some distance from each side of the wound, when, by a special dissection, the outer end of the clavicle with the acromion and coracoid processes of the scapula were thoroughly liberated, so as to permit them to be grasped in the left hand. The mass, consisting of the scapula and its thickened coverings, was then pulled outwards from the side, and the knife was used to sever the stretched tissue between the subscapularis

and serratus magnus muscles. The attachment of the trapezius to the scapula was then divided, as were also the scapular ends of the serratus magnus, levator anguli scapulæ, and rhomboidei, when by a few additional incisions the shoulder blade and the proper scapular muscles were separated from the body. The subclavian artery was compressed over the first rib, and very little blood was lost during the operation. The axillary artery, which had remained patent until near the cicatrix of the original wound was divided, was secured with a ligature, as were also several vessels of minor importance. The edges of the wound were then brought together and united by stitches. Lint, wet with cold water, was then applied over the surface, and the patient was carried to bed, scarcely aware of what had been done.

It would be tedious on such an occasion as the present, and in some respects of little value, to narrate the particulars of the after progress of this case during the patient's stay in the hospital. Suffice it to say that he suffered comparatively little from the operation; the symptomatic fever did not run high; and the weakness left from the operation, fever and subsequent profuse discharge, were not greater than might have been anticipated.

On the tenth day all the ligatures came away. In two days more some sloughs of the thickened subcutaneous tissue, which had been left at the operation, separated; healthy granulations and suppuration soon followed, and the open surface gradually diminished in size under the ordinary dressings.

By the 10th of March he had sat up a short time daily, and on the 5th of May 1847 he was sent down into the country. The wound had not entirely closed, but in every respect he was in better condition than when he came to town.

On the 4th of April 1848, I heard from Mr. Barker, of Wantage, to this effect:—"I have seen Hermon this morning; he remains quite well and fat. We have been teased with occasional small abscesses in the breast, but they are entirely

unconnected with the remaining portion of the clavicle. The openings required for these had the peculiar appearance of strumous sores. The hypertrophy of the soft tissues is now nearly gone, the lungs remain sound, and the case is in every respect successful."

A cast of the shoulder was taken before the operation, which shows the bulk of the parts at that time. One was also taken of the mass which was removed, which shows the thickened state of the soft tissues connected with the scapula. Finally, the bone was cleaned by maceration, and its hypertrophied condition gives good proof of the chronic inflamma-

tory action which had been present so long before its removal. That portion of the glenoid cavity which had been left when the arm was amputated is in a state of caries, the margin of the cavity is surrounded by a mass of new ossific matter, and the lower part of the neck has numerous rough spiculæ projecting from it.

In almost every part of its extent the scapula is thickened and hardened in texture,—changes which are particularly remarkable on the coracoid process, the spine, and the acromion. The portion of the clavicle which was removed partakes of the general condition of the scapula, but there is no appearance of caries upon it.

At the time when this operation was performed, there was a double interest connected with it. It was one of the most formidable and severe as yet effected under the influence of ether, and it was supposed to be the only case of the kind, as a surgical proceeding, which had occurred in this country. The interest connected with the anæsthetic agent has now in some degree passed away; but, in so far as I am aware, the case is still peculiar as one of rare occurrence, and it is chiefly for this reason that I have presumed to bring it under the notice of this society. In various modern surgical works, cases are detailed or referred to wherein portions of the scapula have been removed, either during amputation at the shoulder-joint, by excision of the articulation, or for disease of the bone elsewhere. These proceedings have involved small portions, (such as the spine, acromion process, or glenoid cavity, all of which I myself have removed in different cases,) or as much as three-fourths of the bone. In some instances, the whole of the bone, with a portion or the whole of the clavicle, has been taken away, in consequence of secondary disease, after amputation at the shoulder-joint. In other examples, the upper extremity and bones of the shoulder have been removed simultaneously; and doubtless the surgeons, (Cumming, Mussey, M'Clellan, Gaetani Bey, Rigaud, and Gilbert,) who have resorted to those proceedings, have been encouraged to anticipate success by judging of the

favourable issue of the various examples which have been recorded, wherein the upper extremity, including a portion or the whole of the clavicle, has been torn away by machinery.

In contemplating such an operation for my patient, I felt that there was no want of precedent. In fact, the case related by Rigaud,* of Strasbourg, is in most respects analogous; and the chief point to decide was, whether, under all circumstances, such a formidable proceeding should be resorted to. Three years had elapsed since the arm was amputated at the shoulder-joint; the patient had suffered more or less ever since; and, latterly, the swelling had increased, as had also the discharge, while his health seemed gradually to decline. At an earlier period an operation would probably not have been advisable, as there was a chance of the disease ceasing spontaneously. Further delay seemed passing over the most favourable opportunity for such a proceeding. At one time I was in hopes that, by a partial resection, I might get away all the carious points. A glance at the macerated bone might countenance such a project; but the great enlargement of the soft parts, as well as the numerous sinuses, induced me to adopt the steps which I have detailed. The sloughing of portions of the indurated mass which was left at the operation, and the subsequent strumous abscesses which formed in the remaining parts, perhaps sufficiently prove how much more severe the after consequences would have been, had I left behind any portion of the bone or of the structures with which it was closely invested.

* Comptes Rendus, vol. xix., 1844.

# CASE OF A PATIENT

IN WHOM A

# FOREIGN BODY HAD BEEN INTRODUCED INTO THE PELVIS THROUGH THE VAGINA,

AND

# A DESCRIPTION OF A SUCCESSFUL OPERATION FOR ITS REMOVAL.

By JOHN C. W. LEVER, M.D.,

PHYSICIAN-ACCOUCHEUR TO GUY'S HOSPITAL.

AND

JOHN HILTON, F.R.S.,

ASSISTANT-SURGEON TO GUY'S HOSPITAL.

Received April 27th—Read June 13th, 1848.

E—— P——, 34 years of age, a woman of tall stature, fair complexion, and rather delicate appearance, was admitted into Petersham Ward, Guy's Hospital, under the care of Dr. Lever, Dec. 31, 1847.

Her general health is pretty good. She has had two attacks of acute rheumatism, one when 16 years of age, and another six years ago. Her relatives are stated to be consumptive, and her husband died of phthisis.

*History.*—On the 6th of June 1847, whilst in the act of applying some ointment on the end of a bone netting-mesh to allay a local irritation in the vagina, she was disturbed by a person entering the room, and suddenly sat down. This caused her great pain, and a small quantity of blood escaped

from the vagina, the mesh being forced quite out of sight, so that only the extremity of it could be felt; and in consequence of her repeated fruitless attempts to remove it, was at length forced so far into the pelvis that she could not feel it. Immediately after the accident she discovered that she could not bend her body or sit down, being obliged to keep herself either in the erect or horizontal position.

She has ever since experienced severe pain in the right side of the pelvis, extending down the extremity of the same side: the thigh and leg often feel cold and benumbed. The pain is at times so acute as to make her afraid to attempt any movement, and it is always increased by any sudden jerk or motion, as treading on a stone, &c.

During the summer months she was able to walk a short distance, and to go up and down stairs without any great inconvenience: but in November her health became impaired; and the pain was so severe as to confine her to bed, and to require large doses of opium before any relief was obtained.

Before admission into the hospital, she was seen by Mr. Callaway, who requested Dr. Lever to examine the uterus: this was performed by the finger, and by the uterine sound, but he could detect nothing in its cavity. Subsequently the case was treated, by another physician who was consulted, as one of severe sciatica.

*Symptoms on admission.*—She appears much exhausted and emaciated from the protracted suffering she has endured; she complains of severe pains extending from the posterior part of the thigh and leg to the heel; this pain is at times much more intense than at others, and during the paroxysms she obtains some relief by extending the limb as much as possible. The pain appears to follow pretty exactly the course of the great ischiatic nerve, over the situation of which, as it emerges from the pelvis, there is much tenderness on pressure. There is also some amount of tenderness in the right inguinal region, especially on making firm and deep pressure, but neither the anterior crural not obturator nerves appear

to be implicated: there has not been any tendency to maintain the thigh fixed upon the pelvis.

During her illness the menses, though scanty in quantity and attended with pain, have appeared regularly; and in the intervals there has been slight leucorrhœa.

The bowels are so confined as to render the constant use of aperients necessary; there is slight pain in defæcation, but the evacuations have not been observed to be flattened, or to assume any unusual form. Micturition is painful and difficult, and, when attempted, only a small quantity of urine passes, and much time is consumed before the bladder can be emptied.

But little sleep is obtained without the use of opium. The tongue is clean; the appetite somewhat deficient; the pulse 96, feeble; the sounds of the heart rather harsh. Respiration is natural, and, by external examination, nothing abnormal can be detected in the abdomen. The right lower extremity is wasted, and much smaller than the left.

*Per vaginam scrutans.*—The pelvis is large, and the vagina capacious; the cavity of the latter is not constricted at any part, nor is there any cicatrix to be discovered. The end of the examining finger impinges on a resisting substance, which appears to be from a quarter to half an inch broad, but neither extremity of it can be reached. It is lying obliquely in the pelvis to the right of the vagina, (the parietes of which can be rolled over it,) and its direction appears to be, stretching from the tuberosity of the right ischium towards the right sacro-iliac-synchondrosis.

The patient's general health was attended to, and improved under the employment of tonics and a generous diet, while the pains were for a time mitigated by belladonna plaster and liniment, but again became excessive on the setting in of the cold weather.

1848.—Jan. 23rd.—At Dr. Lever's request, Mr. Hilton examined the patient to-day, and expressed his conviction that the foreign body was lying obliquely in the pelvis, with its lower extremity firmly fixed near the tuberosity of the

right ischium, and close to the foramen ovale; and its upper extremity (which seemed a little moveable) extending in the direction of the right sacro-iliac-synchondrosis. It could be distinctly felt through the vagina or rectum, and also by a catheter introduced into the bladder. Its situation was external and to the right of these pelvic viscera. The internal pudic artery was felt pulsating over its lower extremity, but no blood-vessel could be detected over the more central portion of it. Pressure from the vagina upon this part caused an increase of pain in the course of the great ischiatic nerve. The patient was examined in different positions, in order to ascertain how the foreign body might most easily be reached from the vagina. It was felt least distinctly when the patient was lying on her back, and most readily when the patient was placed on her left side; but Mr. Hilton thought the operation could more easily be performed with the patient resting on her right side.

Jan. 24th.—She suffered a good deal of pain yesterday after the examination, and had but little sleep last night; and she feels rather low this morning. Pulse 90, rather feeble. Tongue clean and moist. The bowels have been relieved by ol. ricini.

The operation was performed at half-past twelve o'clock. The bladder being first emptied by the catheter, the patient was placed on her right side. Mr. Hilton having felt the foreign body distinctly through the vagina, directed, that in order to force it towards the vagina, and to keep it steady, pressure should be made upon the lower part of the abdomen by an assistant. The parietes of the vagina being separated from each other by the aid of two bone spatulæ, Mr. Hilton placed the end of the forefinger of his left hand upon the extraneous body, and, with a scalpel thus directed, cut down upon it: this was attended with some difficulty in consequence of its edge presenting to his knife. The mesh was laid hold of by a pair of long dressing forceps, and an effort was made to move it, and extract it whole, but without effect, from the fixity of position it had acquired. An aneurism

needle, armed with a long silk ligature was next introduced through the incision, and placed underneath the mesh, and, after one or two attempts, the double silk was seized with forceps and drawn into the vagina. The loop of silk, being now divided, formed two separate ligatures, which were tied, one round the upper, and the other round the lower, part of the portion of the mesh which had been denuded by the incision. The mesh was then divided between the ligatures with a pair of bone forceps. A long pair of dressing-forceps being now introduced into the vagina, the upper portion of the mesh was seized and withdrawn downwards (measuring four inches in length), and immediately after the lower portion was raised from its position near the foramen ovale, and then brought through the incision. This shorter portion measured one inch and five-eighths in length.

The ligatures were not used with the view of being of any service in the extraction of the foreign body, beyond keeping the two portions steady after division was effected, and preventing their slipping out of reach.

Not an ounce of blood was lost during the operation, which, although somewhat tedious, was borne by the patient with the greatest fortitude. She merely complained of increased pain and numbness, from having been placed on the affected side. The catheter was passed immediately after the operation, and about ʒij. of clear, healthy urine withdrawn. Ordered,—

℞. Opii ♏xxx. st.

The bone mesh, after removal, measured five inches and five-eighths in length; a quarter of an inch in breadth; one-eighth of an inch in thickness.

4 P.M.—She is lying with her knees drawn up, and complains of having had pain in the abdomen since the operation. The pain is increased by pressure, inspiration, or motion, and is most intense in the right iliac region. There is a feeling of nausea, and of constriction about the scrobiculus cordis, and she has vomited a greenish fluid. She is cold, and has had a disposition to shiver, but the skin is now warmer, and rather perspiring. The countenance is anxious; the pulse 100, and jerking. She has no pain in the right lower extremity, this having been completely relieved immediately after the removal of the mesh.

Cataplasma, lini. abdom. app. ℞. Opii ♏xxx. st.

12 P.M.—The patient vomited after taking the opium. She was now ordered two grains of solid opium directly, and one grain to be repeated every four hours: the temperature of the ward was to be kept up, and a little beef-tea and arrow-root to be taken occasionally. She has felt much warmer and more comfortable, having less pain and nausea, and the countenance is improved. The pulse 92, full, soft and compressible. The tongue is whitish; but she complains that her mouth feels parched; the skin is rather hot; there is no pain in the head; and the knees are not drawn up, although some abdominal tenderness remains, probably attributable to the pressure exerted on that part during the operation. Eight ounces of high-coloured acid urine have been withdrawn by the catheter.

Jan. 26th—11 A.M.—The vomiting returned at 1 o'clock, and has continued at intervals, increasing the abdominal pain. The pulse is small and jerking, 110. She was ordered iced water. Hyd. chlorid. gr. j. Pulv. opii gr. ſs. in formâ pil. tertiâ quâque horâ; and Catap. lini. abdom. $2^{dis}$ horis applic.

These measures, together with the syringing of the vagina, and the introduction of the catheter, were persevered in until the evening of the 26th, when, as her gums were

affected, the pills were discontinued, and a more generous diet was allowed.

From this time, until Feb. 1, the patient continued steadily and progressively to improve; the discharge of pus from the vagina gradually diminishing, and at length ceasing altogether. She rapidly regained her health and strength, and was soon able to walk perfectly well without assistance, not having had the least return of pain or numbness in the right lower extremity since the operation; and on Feb. 22, 1848, she left the hospital perfectly well.

The chief feature in such a case as that which has been related may, by some, be found in the rarity of its occurrence, and in that aspect alone it is interesting: but it certainly leads to more worthy considerations when we reflect on its details;—the pain and distress with which the patient was and would have been afflicted during the detention of the extraneous body in the pelvis, and the risk of danger in the employment of any operative means for its displacement. We have an instance of an extraneous body—a portion of bone nearly six inches long—forced through the walls of the vagina, the pelvic fascia and the cellular tissue, and, in all probability, through the right broad ligament, (or it might have been only pressing this ligament with great tension upwards and backwards,) so as to reach the locality of the lumbo-sacral or first sacral nerve, without causing any important hæmorrhage, or inducing any very serious inflammatory mischief, at that time or subsequently. It is also worthy of notice that, so far as could be ascertained, this piece of bone had not led to any chronic inflammatory deposits in the immediately surrounding surface, nor to any secondary local disturbance, except that produced by its direct pressure upon the nerve. It may be certainly inferred that the upper end of the mesh was not placed upon the anterior crural or obturator nerves, from the whole of the nervous symptoms having been referred to the parts of the body below their peripheral distribution; and on the other hand it seems

to be quite clear that it had rested for some time, and did rest up to the period of the operation, upon some of the nerves forming the sciatic, from the whole of the painful nervous symptoms, the muscular wasting, and diminished temperature having been in accordance with its known muscular and cutaneous associations; and, further, from the pain being increased, by pressure upon the mesh, in the direction of the first sacral foramen, and from the immediate and complete relief obtained by its removal. It would appear that the lower end of the mesh was fixed near the margin of the obturator foramen, to the outer side of the right internal pudic artery. It will be evident also that the mesh could not have perforated from below its then situation through the vagina; indeed, there is every reason to suppose that it had traversed the walls of this canal at a higher point, and had subsequently gravitated to the spot at which it became fixed. It is perhaps worthy of a passing remark, that the long detention of this piece of bone, in contact with living tissues, had not produced any recognizable alteration or change upon any of its surfaces.

After the operation the patient was severely ill, and it was within a probability that she might have died from inflammation of the pelvic tissues or from extending peritonitis. Knowing well how susceptible and liable to dangerous inflammatory mischief the pelvic fascia and areolar tissue become after surgical operations in the neighbourhood; yet, considering the size of the extraneous body and its remarkable position, the severe pain and atrophy of the limb, together with the increasing deterioration of the general health, which resulted from its presence, and that there did not appear any probability of its being removed by a suppurative or ulcerative process,—we concluded that the operative means employed for its removal were not only justifiable, but to be recommended.*

* The report of the foregoing case was compiled by the Authors from Notes taken by Mr. T. Beavan Rake.

CASE

OF

# OBTURATOR HERNIA,

## SIMULATING INTESTINAL OBSTRUCTION WITHIN THE ABDOMEN;

## TO RELIEVE WHICH GASTROTOMY WAS PERFORMED.

By JOHN HILTON, F.R.S.,

ASSISTANT-SURGEON TO GUY'S HOSPITAL.

Received June 26th—Read June 27th, 1848.

Miss ———, aged 36 years, a tall, thin person, and in delicate health, had an attack of vomiting, with constipation of the bowels, in September 1847, which, after continuing four or five days, yielded at that period to the effect of aperients with laxative injections, and the application of leeches and fomentations to the seat of pain in the right inguinal region, above Poupart's ligament. Since that time she has frequently had pain in the bowels of a spasmodic character, which has been relieved by her taking brandy and water. The bowels have been generally constipated.

On the morning of Thursday, January 20th, without any obvious cause, she had an attack of vomiting, which continued, with intervals of relief, until 11 P.M.

When Mr. Blackmore, surgeon, of Old-street Road, first saw her, no hernia was perceptible; there was not any pain on pressing the abdomen, nor was there any distention of it. The pulse was 84. She had taken castor-oil twice, and rejected it each time. Mr. Blackmore ordered a large

mustard plaster to be applied over the stomach, two grains of calomel and five of ext. coloc. co. to be taken every two hours with some effervescing medicine.

21st, Friday—10 A.M.—Much the same; no action of the bowels; the vomiting continues; pressure upon the abdomen relieves somewhat the spasmodic pain; an aperient injection to be used, and one-half drop of croton-oil added to the pills. 8 o'clock P.M.—No change in symptoms, except more pain around the umbilicus, at which part eight leeches are to be applied, and their application to be followed by a warm-bath; the aperient pills to be omitted; one grain of powdered opium to be given at night.

22nd, Saturday—10 A.M.—Has had some sleep and is more free from pain, and there is less frequent vomiting: pulse 84. Omit all medicine, and give a little fluid nourishment. Secretion of urine scanty but healthy. Fomentations to abdomen. 9 P.M.—Continues much the same as in the morning; an aperient injection to be administered.

23rd, Sunday—10 A.M.—Is in about the same state as yesterday. 9 P.M.—Dr. Fox met Mr. Blackmore in consultation. Pulse 96. Tongue more dry. Slight hiccough. Has vomited fæcal matter several times to-day; no distention of the abdomen, and but little pain on pressure. Apply mustard plaster, followed by large linseed-meal poultices over abdomen, and give calomel gr. x., with one grain of powdered opium at night. Discontinue other means.

24th, Monday—9 A.M.—Has passed a good night; symptoms much the same in other respects. 10 P.M.—Has had no vomiting nor any action of the bowels: repeat the opiate, with calomel gr. v.

25th, Tuesday—10 A.M.—Has not passed a good night; vomiting has returned with occasional hiccough; tongue more dry in centre; pulse 108. A blister to be applied at the only painful part of the abdomen, namely, the left side of the umbilicus; this to be followed by a linseed-meal poultice: omit the opium, as it made her sick the last time she took it.

26th, Wednesday—10 A.M.—Has had a good night, and appears upon the whole better. Vomiting much diminished. An injection of castor-oil brought away some fæculent matter from the bowels; continue to give nourishment in small quantities, and discontinue medicines.

From this time until Saturday night, the 29th, she continued in the same state, when Dr. Fox saw her again, in consultation, and ordered small doses of hydrochlor. morphiæ every two hours, and the lower bowel to be stimulated by a small turpentine injection in the morning. The morphiæ retained; the injection did not cause any sickness, nor did it give any relief to the bowels. She expressed herself as feeling better, notwithstanding the fatigue occasioned by the injection.

31st—9 A.M.—She has not had any vomiting during the last forty-eight hours; no increase of pain in the abdomen, but no relief from the bowels: the pulse is 120, soft; tongue moist, and clean at the edges.

At this period I was requested to see the patient, in consultation with Dr. Fox and Mr. Blackmore.

The patient was lying upon her back; the face was thin, with a distressed aspect: tongue dry and brown, its centre furred on either side; breath very offensive, smelling like fæculent matter: pulse 120, small. The abdomen was soft, somewhat pliant, and but little distended; neither gentle pressure upon the abdomen, nor the examination by concussing it, produced much pain. On pressing deeply on any part below the level of the umbilicus the patient complained, and more especially so about an inch to the left of the umbilicus. The abdomen was very resonant over all the gastric and intestinal portion of the abdomen, excepting below the umbilicus, where it was chiefly dull on percussion, although there were portions of that surface quite resonant. Every now and then the whole surface of the abdomen became remarkably retracted, uneven, and quite undulatory or wavy, during which time the patient experienced spasm of the belly, and the course of the subjacent convolutions of intestines could be distinctly felt and seen. This condition

lasted about a minute, or less, then subsided, and again returned after a lapse of several minutes. No hernia could be detected. Whilst at the bed-side she vomited the fæculent contents of the small intestines, well coloured with bile, and looking more red than natural. The quantity of urine secreted had been very small, about four ounces in the preceding twenty-four hours.

On consulting, we could come to no other conclusion than to consider this a case of mechanical obstruction in the small intestine, and one which offered no hope for the patient by any means short of opening the abdomen. That the obstruction was not in the large intestine might be legitimately inferred from the abdomen not being much distended, from the capability of the colon to retain nearly three pints of injection without distress, from the vomiting having come on so early in the attack, and from the secretion of urine being very scanty.

It had been suggested that metallic mercury should be administered; but ultimately, on reflection, it was not employed. Guided in part by the history of the symptoms which occurred last autumn, our impression was, that the cause of the obstruction would be found either to the right of, or rather lower than, the umbilicus, where the chief pain was at that time experienced, or to the left of the umbilicus, where deep pressure now produced some pain.

After explaining to the friends of the patient, and to the patient herself, her then condition, and her prospect, without something could be done by surgical means; and letting her understand that the inhalation of chloroform would cause her to experience but little, if any, pain during the operation, the patient herself and her friends acquiesced in our suggestion to explore the abdomen the next morning, provided no manifest improvement should intervene. Two or three doses of morphia were prescribed to be administered during the night, and directions were given for the house to be made as warm as possible, and to be kept so. On the following morning, no important improvement was observable in the

patient's symptoms, but there had not been any vomiting during the night, and she had had some sleep. The tongue was more extensively dry. The pulse about 120 in the minute; the abdomen more prominent; the breath still of a fæculent odour.

The catheter was introduced, and about an ounce of urine abstracted. The hair was shaved off the pubes. The patient's head and shoulders were raised, and under the thighs was placed a large pillow, so as to relax as much as possible the abdominal walls. Chloroform was then administered by Dr. Gull. A napkin was folded into the form of a hollow cone, with the apex open, a piece of sponge was placed within it, and the chloroform poured upon it. This was held over or allowed to rest upon the patient's face so as to cover the nose and mouth, and in about two minutes, the insensibility appearing to be complete, I began my incision at the umbilicus, but the patient evidencing some sensibility I did not proceed for about another minute. I then continued the incision downwards to near the pubes, cutting through skin and cellular tissue and numerous small veins, so as to expose the median line of tendons. The natural colour of the tendinous structures and the more opaque line of the linea alba were obscured by blood, and when the vertical median section was extended into the parts then exposed, it divided the linea alba in part only, and opened also the sheath of the left rectus; so that it was clear the linea alba was somewhat deflected from its normal course. Two little arteries required ligatures. When all bleeding had ceased, the peritoneum was opened near the umbilicus, and its division completed downwards upon a broad director. A small quantity of serous fluid, coloured with blood, flowed from the peritoneum. The small intestines, somewhat distended and presenting numerous small red ecchymosed spots of inflammation upon them, occupied the opening. On introducing the hand into the peritoneum to ascertain the cause of obstruction, nothing abnormal could be detected. As it was now my wish to get a view of empty intestine I found the opening I had made was not long

enough; it was, therefore, extended upwards, close to the left side of the umbilicus, to about an inch above it; in doing this a small artery was divided, and required a ligature. The convolutions of the small intestines were now displaced from the left side of the opening, and a piece of the colon, somewhat distended with gas, brought unexpectedly into view. This distended condition of the colon complicated, at first thought, the prospect of finding the obstructing cause; but the conclusion was obvious that this cause must be so located as to press upon the colon and to obstruct the small intestine at the same time. On separating the left side of the colon from the small intestines a few coils of perfectly pale, contracted and empty small intestine were seen, and, on tracing them downwards, I found that one of them had entered the obturator foramen of the left side, so that, in fact, we had met with an obturator hernia. I endeavoured to withdraw the intestine from the foramen by pulling it gently, and with a little perseverance in this traction, and by pressing at the same time deeply and firmly in the thigh, I succeeded in displacing it from the obturator foramen, and then retaining the portion of intestine between my finger and thumb, I brought it into view; it was very dark coloured but not gangrenous, nor was it ruptured. Seeing it in a recoverable condition, it was allowed to find its own position amongst the convolutions of the intestines. The omentum was not seen during the operation. The intestines were carefully replaced in the abdomen, although with some little difficulty. The edges of the wound were brought together by a continued suture from below to above, including the skin and cellular tissue. A pad of lint was placed over the wound and maintained there by some broad straps of plaster across the abdomen. The patient being much collapsed was not moved from her then position, and bottles of hot water enclosed in a blanket were applied to the hands and feet, and some brandy was administered.

Within a quarter of an hour after the operation was completed the patient had entirely recovered her sensibility, having been completely under the influence of chloroform

for about an hour. The pulse was then 156. She says she has not felt anything of the pain from the operation, but complains much of griping and twisting pains in the abdomen. She rejected from her mouth, with slight efforts at vomiting, some fæculent matter. A small quantity of brandy, diluted to one half, was given her, and as the pain in the abdomen was very much complained of, a suppositary of ten grains of opium and soap pill was passed into the rectum. During the next hour the pulse was uniformly as rapid as 156, very feeble; hands cold and clammy; no further vomiting. The patient was quite calm and collected, but complained very bitterly of pain in the abdomen.

11½ A.M.—Pulse 156, feeble but distinct; skin moist and warm; respiration 26; tongue dry and coated. She passes a considerable quantity of flatus upwards from the stomach.

1 P.M.—She complains of pain in the abdomen at intervals,—"a contracted feeling," as she expresses it. The pulse is now 144, rather more full. She has dozed at intervals for about ten minutes or a quarter of an hour at the time. She continues to pass a quantity of wind; ordered a third of a grain of hydrochlorate of morphia to be administered, and small quantities of beef-tea and brandy from time to time.

2½ P.M.—She is much in the same condition; she has not complained of so much pain since she took the morphia; pulsations about the same (144); skin cold and moist; respirations 26 or 28 per minute.

4 P.M.—Is still very comfortable. She continues to doze, and wakes up complaining of slight pain; pulsation and respiration about the same; one-sixth of a grain of morphia given.

5 P.M.—Pulse more rapid (150), and less distinct; her hands are cold and clammy; she wished to pass some water, but objected to the use of the catheter; she continues to take beef-tea and brandy at intervals.

7 P.M.—She is very much lower; the pulse is more rapid and almost indistinct; she has become very restless, throwing her arms about continually; she has passed a small quantity of urine (about ʒij.); beef-tea and brandy continued,

and another dose of morphia given; hot bricks were placed at her sides as she complained of being very cold.

8½ P.M.—She is sinking rapidly; great restlessness; pulse scarcely to be felt; skin cold and clammy; is continually asking to be moved; respiration more rapid: morphia, one-sixth of a grain.

10 P.M.—There has been no perceptible pulse for some little time; respiration hurried; complains of pain. She was moved higher up in the bed about 10 o'clock, after which she moaned for about five minutes, and expired.

After the operation Mr. Robert Stedman, a most praiseworthy Guy's student, kindly remained with the patient, and superintended, with Mr. Blackmore, the treatment of the case.

*Post-mortem examination*, sixteen hours after death.—The edges of the external wound were found adherent by recent lymph, and on separating them the convolutions of the small intestines were seen feebly affixed to each other, and to the abdominal parietes. On exposing completely the whole of the abdominal cavity no distention of the intestines was manifest, and the colon had returned to its natural position. There was very marked evidence of general inflammation of the peritoneum in the lower half of the abdominal cavity; no distinctly empty intestine could now be seen; the small intestines below the strictured portion being now equably distended. The cæcum and right colon were occupied by fæculent matter. The previously strangulated piece of intestine, about an inch and a half long, was lying to the left of the umbilicus, and could be readily recognized by its much darker aspect than the surrounding intestines; but there was no evidence of a gangrenous condition. This portion was situated rather above midway between the cæcum and duodenum.

The stomach presented an hour-glass contraction, and contained some of the same kind of intestinal matter as that which the patient had previously vomited.

The obturator foramen on the left side, through which the

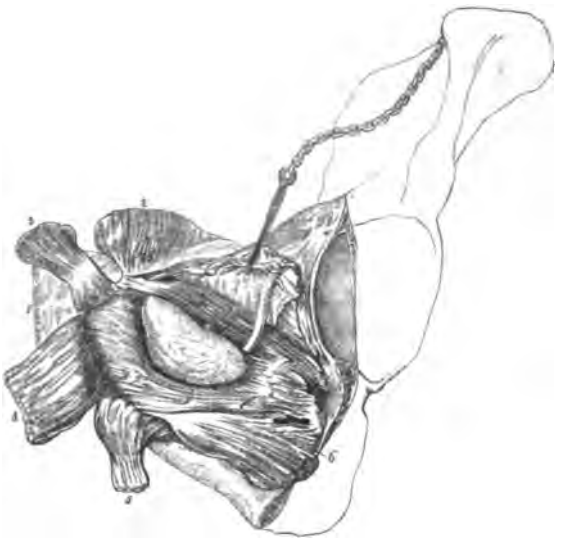
piece of intestine had passed, admitted, without much pressure, the little finger only; its fascial edge was very distinct and unyielding, and on its peritoneal circumference there was a vascular fringe of fibrine, most observable towards the pubes, and to which, no doubt, the portion of intestine had been attached, and so retained in its abnormal position. The patulous condition of the obturator foramen on the right side was more distinct than on the left side; it was large enough to admit freely the forefinger, but there was no evidence of any adhesions connected with it.

No pathological evidence was discovered of any old inflammation in the form of bands or cellular adhesions in the general cavity of the abdomen. The hernial sac and the surrounding parts were removed for further examination. The hernial protrusion had taken place at the usual position of an obturator hernia, and the sac remained fixed in the upper part of the thigh.

The obturator nerve passed with the artery by the outer side of the sac. The artery, in this instance, was derived directly from the external iliac artery. These structures were not adherent to the sac, but enclosed or attached to a layer of the abdominal fascia which had descended with the peritoneum.

On prosecuting the dissection below Poupart's ligament, by raising the pectineus, adductor longus and brevis, a dense layer of fascia was exposed, covering the obturator externus muscle and the hernial sac: after dissecting this fascia from the anterior surface of the obturator muscle, and turning it upwards, the fundus of the hernial sac was seen somewhat thickened and strongly adherent to the inferior surface of this same fascia, having perforated the upper part of the obturator muscle. Only a small portion, however, of the muscle was crossing over the sac. The relation of the hernial sac to the surrounding structures is well seen in the accompanying sketch of the parts. The portion of the obturator muscle which passed over the sac would have been in this case more than sufficient to produce strangulation of the

contents of the sac. It is clear this muscle may be the cause of the stricture in obturator hernia, and in a like case, until the fibres of this muscle could be relaxed, it would be perhaps impossible to reduce a strangulated obturator hernia, even if detected during life.



*Description of the Wood-cut.*

No. 1. Symphysis pubis of left os innominatum.
„ 2. Pectineus divided and turned upwards.
„ 3. Adductor longus.
„ 4. Adductor brevis.
„ 5. Gracilis.
„ 6. Obturator externus perforated by the hernial sac.
„ 7. The fascia which covered the obturator externus muscle drawn upwards, with the obturator nerve attached to it.

Before opening the abdomen of this patient I thoroughly examined her in reference to any hernial tumour, without finding any evidence of it. Being still satisfied that the symptoms were produced by some mechanical obstruction to the small intestine, I proceeded, with the expectation of finding the cause within the abdomen. Judging from the character of the previous inflammatory symptoms in Sep-

tember 1847, and from the local tenderness now experienced by the patient near the umbilicus, I was in hopes to have found the obstruction near the umbilicus, or in the right groin. In neither of these positions could I find any obstructing cause; and it was only by observing the pale, empty and contracted intestine toward the left side, that I was enabled to reach the true cause. Having ascertained the existence of an obturator hernia, I endeavoured to discover whether any tumour could be detected by an external examination below Poupart's ligament; but nothing of the kind could be felt, so that I may affirm, with confidence, that in this case, and at the same period of the symptoms, no evidence, or indication, or even suspicion of an obturator rupture strangulated could have been acquired from the existence of any tumour in the thigh.

Obturator hernia strangulated may be considered a rare occurrence, and has been so little associated with the question of opening the abdomen to relieve internal strangulation, that I admit my attention was pre-occupied with the idea of discovering one of the more common causes of obstruction. If, however, the probable existence of an obturator hernia had occurred to me before, or at an early period of the operation, the ulterior intention of the operation might have been accomplished without exposing the patient to the risk associated with so prolonged an exploration as was found necessary, by at once introducing the hand into the pelvis, where the intestine might have been discovered passing through the obturator foramen.

As I stated in the report of the case, the administration of metallic mercury was thought of but not employed; yet it is possible that the use of a considerable quantity might have been of service, from its weight sinking into the pelvis below the level of the obturator foramen, and by thus dragging upon the intestine it might have displaced it from its incarcerated position; so that I think, in a like case, provided it could be diagnosticated, metallic mercury ought to be had recourse to.

In this case the secretion of urine was small in quantity; and this fact is, as far as I have seen, in accordance with previous observation, associated with the position of the intestinal obstruction; so that it may be stated that the nearer the obstruction may be to the stomach, the less will be the urinary secretion; with this diminished secretion of urine should be associated the great vomiting as one of its causes, which takes place in such a case. Whilst I think it right to attach some degree of importance to this urinary test, as one of the contributing means towards a correct diagnosis, and as an interesting physiological observation, yet I am anxious to admit that, in the instance before the Society, it gave no aid whatever in discovering the locality of the obstructing cause.

The symptoms which the patient experienced in September were most likely not the result of an inflammatory attack, but of an obturator hernia on the right side. This inference may be arrived at by the negative indication of there being no post-mortem evidence of the result of any inflammation, and from the fact of there being ample room on that side for the entrance of a portion of intestine or omentum into the obturator foramen, which was very remarkably patulous.

Reflecting upon all the associated circumstances of this case, I think it must be admitted there was no probability that any other means than those employed would have offered her any hope of prolonging her life, excepting the obturator hernia could have been discovered before the abdomen had been opened; and from what has been already stated, it is pretty clear that it could not have been so detected by external examination, and there were certainly no special or peculiar symptoms pourtraying its existence.

It is evident this patient died from the effects of acute and rapid peritonitis, the result of opening the abdomen.

Although in this case, as in my previous operation, the details of which are recorded in the last volume of the

Transactions of this Society, the issue has been unfavourable, still I am strongly impressed with the propriety of making such attempts at relieving cases, which, if left to themselves and medicine, would almost certainly be fatal; and I am quite sincere in the belief that some few lives will be prolonged by persevering in the same operative procedure of opening the abdomen.

# THE HISTORY OF A CASE

OF

# DISLOCATION OF THE HEAD OF THE FEMUR, BACKWARDS,

WITH

## SOME OBSERVATIONS ON THAT FORM OF DISLOCATION.

By RICHARD QUAIN,

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SURGEON TO UNIVERSITY COLLEGE HOSPITAL.

Received June 27th—Read June 27th, 1848.

Opportunities of ascertaining, by dissection, the exact position of the bones and the condition of the surrounding soft parts in cases of dislocation, especially those of recent occurrence, are so infrequent, that every example of the injury examined under such circumstances becomes a study of value to the practical surgeon. It is on this account that I venture to bring under the notice of the Society a case of dislocation of the femur, at the hip joint, which I dissected soon after the accident by which the bone was displaced, and without any attempt having been made to restore the bone to its natural position.

Maurice Coghlan, ætat. 60, a stout man, employed as a bricklayer's labourer, while carrying a burden up a ladder, when he had ascended about thirty feet, was observed by one of his fellow-workmen to pause, and then instantly to fall to the flagged court on which the ladder rested. He was taken

up lifeless, and his body was brought to University College Hospital, June 11, 1845.

The cause of death was found to be an injury of the head. The skull was fractured over the right parietal eminence, and the fracture extended completely across the base of the cranium, through the body of the sphenoid bone and the petrous part of the temporal bone on each side, rupturing both the internal carotid arteries at the cavernous sinuses. In the base of the skull the pieces of the broken bone were widely separated. Something very unusual having been observed in one of the lower limbs, I made a careful examination into its condition, assisted by Mr. J. T. Griffiths, heretofore my intelligent house-surgeon. The result was as follows:—

As the body lay on the back, the right lower limb was a good deal deformed. It appeared considerably shorter than its fellow, the knee being from two to three inches higher than natural. But notwithstanding the apparent shortening of one of them, only a slight difference was detected between both limbs, upon measurement of the distance from the respective superior spines of the iliac bones and the external malleoli. The dislocated limb was, however, a little the shorter of the two. It was likewise inverted in its whole length, the patella being inclined inwards, and the foot resting on its inner side upon the table which supported the body. The whole limb was further back than the sound one, and at a distance from it.

The great trochanter of the femur, which was readily distinguished, was altered in its position with respect to the iliac spine; and the depression or flatness that naturally exists behind that prominence was wanting. Towards the back part of the pelvis was found the head of the femur; but it was far from being so easily detected as the trochanter. The movement of the limb forwards (flexion) was easily effected; its rotation outwards was impracticable. It should be added that, at the time the body was examined, there was no cadaveric rigidity. The preceding statement of the ex-

ternal appearances is illustrated in a cast, (exhibited to the Society when the paper was read,) which includes the lower part of the trunk and both the thighs.

*Dissection. — The bones.*—The gluteus maximus being removed, the head of the femur was in view. It lay, with a moderate quantity of blood around it, below the pyriform muscle and immediately behind the acetabulum, over the base of the ischiatic spine, and opposite to a part of each of the two sacro-sciatic foramina. From the pelvic bone it was separated by the obturator internus and the gemelli muscles. The crista of the ilium was broken off, and the bone was likewise broken through its dorsum for the length of three or four inches, the fracture extending backwards into the great sciatic notch; but the edges of this fracture were separated by only a narrow space, and there was no looseness of the parts.

*The muscles.*—The gluteus maximus was uninjured. The gluteus medius was found in a state of relaxation at its back part, and some of the deeper fibres of this muscle, being connected with the ilium over the fracture above noticed, were torn. As regards the other muscles, the pyriformis (which it has been already stated lay immediately above the head of the femur) was slightly stretched; it might be said to have been held from falling loose rather than stretched; but the gemelli and the obturator internus were in a state of extreme tension. The last-named muscles, with the capsular ligament of the hip-joint on which they rested, separated the head and neck of the femur from the acetabulum, and from the surface of the innominate bone behind that cavity. The only muscles which sustained real injury from the dislocation were the obturator externus and the quadratus femoris. Both were torn quite across.

*The joint.*—The capsular ligament was torn at the internal and lower part of the joint, or, rather, was separated from the neck of the femur in this direction; while the posterior and the upper part of the same structure were entire. The ligamentum teres was torn out of the depression on the head

of the femur. The edge of the acetabulum was broken off at its upper part, but only to a small extent; otherwise the articular cavity was uninjured.

Over the neck of the femur was stretched the *great sciatic nerve*, which had passed into contact with the bone in the interval between the fragments of the quadratus muscle. Between the nerve and the bone was interposed the broken tendon of the obturator externus. Most of the facts brought to light by the dissection are represented in the accompanying drawing, for which I am indebted to the pencil of my friend, Mr. Noah Brangwin.

A comparison of the foregoing details with the generally received account of the dislocation will show several points of difference between them; at the same time that a full examination of the facts, at present ascertained, will lead us to correct some of the opinions which are commonly entertained respecting the nature and proper management of the displacement. The further observations will be arranged under the following three heads:—

1st. The condition of the structures immediately interested in the dislocation, and especially the exact position of the head of the femur: 2nd. The characteristic signs of the displacement: and 3rd. The course to be pursued in order to restore the bone to its natural position.

1st. Of the cases in which the result of post-mortem examination of the parts has been recorded, the first that requires notice is described in the work of Sir A. Cooper, where the dislocation of the head of the femur, backwards, or into the sciatic notch, is treated of;* the second dissection is reported by Dr. Scott;† and the third, conducted by Mr. Billard in the presence of Professor Béclard, has been published by the former.‡ This short list shows the materials

* A Treatise on Dislocations, and on Fractures of the Joints, by Sir A. Cooper, Bart. 4th ed. p. 68, and plate iv.

† Case of Dislocation of the Hip-joint, and the manner of its reduction and the appearances on dissection. By James Scott, M.D., in the Dublin Hospital Reports, vol. iii. 1822.

‡ Luxation du Femur en arriére et en bas, in the Archives Générales de Médecine, tom. iii. p. 538. Paris, 1823.

for arriving at a satisfactory conclusion respecting the first of the subjects of inquiry above proposed, to be scanty. But they require on this account the more careful examination, in order to interpret them aright; and such examination will, I believe, lead to a more correct determination of the nature of the displacement than that which is usually received. Before we enter into particulars, a few remarks are necessary concerning the respective value of the cases above referred to for the purpose here in view.

Sir A. Cooper's dissection was made at a remote period from the occurrence of the injury, the person having survived it "many years," according to the opinion of the eminent observer himself. The structures about the joint had therefore undergone much change, and all the more because of the effect which the weight borne on the limbs must have produced. There is, moreover, no account of the person from whose body the joint was removed, neither is there any statement of the position or of the length of the limb. For these reasons the case in question, unless supported by others not liable to the same objections, cannot be regarded as illustrative of the alteration of structure which accompanies the dislocation. With respect to Dr. Scott's case, the reduction of the displacement having been effected before death, the amount of injury, sustained by the parts around the joints in consequence of the accident, cannot be very clearly separated from that which might have resulted from the efforts to restore the femur to the acetabulum. Still this case is valuable in so far as it corroborates the evidence afforded by others. To the objections made in the preceding remarks, the cases observed by Billard and myself are not liable. They were examined immediately after the accident, and without any attempt having been made to remove the head of the femur from its accidental position.

From the cases I now turn to an examination of the leading facts they exhibit:—The head of the femur is stated by Sir A. Cooper to be lodged on the pyriform muscle, at the edge of the sciatic notch; and it is spoken of as "buried in the

notch." Dr. Scott found the same part of the thigh bone below the pyriformis, where the nerve passes beneath that muscle, or rather found evidence of its having been so placed; and it occupied the same position in Billard's case and mine, —that is to say, the head of the femur in these instances was immediately behind the acetabulum, and opposite the interval between the two sacro-sciatic foramina.* Here, then, is a material difference, the statement of Sir A. Cooper placing the bone considerably higher than it was found in the other cases; and it is important to decide which of the positions indicated is the more accurate.

With a view to elucidate the point, I performed some experiments on the dead body. After removing the gluteus maximus and dividing the quadratus femoris and the obturator externus, as well as the inner and lower part of the capsular ligament with the ligamentum teres, I reproduced in several instances the dislocation, as it is represented in the drawing; and I then found that the length of the limb, as compared with its length before the head of the femur had been displaced, was diminished by $\frac{1}{8}$ths of an inch. Slight variations of length were noticed in different bodies, and even on the opposite sides of the same body, owing probably to the varying degrees in which the capsular ligament happened to be divided at its lower part.† In the experiments I found like-

* Mr. Wormald has published an account, accompanied with a drawing, of an interesting case of dislocation backwards and "downwards," which I have not taken into account in these observations, in consequence of the head of the femur having been lower than the position assigned in this paper to the common form of the dislocation backwards. The femur in Mr. Wormald's case was "on the ischium, opposite to the lesser ischiatic notch and the upper part of the tuberosity." The difference is so small between this and the cases adverted to in the text, that it might well be considered a modification of the dislocation backwards. See a paper entitled, Cases of Dislocation of the Head of the Femur, (Case I.) by Thomas Wormald, Esq,, in the Medical Gazette, vol. xix. p. 657. London, 1837. And A Descriptive Catalogue of the Anatomical Museum of St. Bartholomew's Hospital, vol. i. p. 128. London, 1846. The preparation is preserved in the Museum.

† It is often difficult, in consequence of some peculiarity in the construction of the bones, or the manner in which they are covered with the soft

wise that, in order that the head of the femur should reach the sciatic notch, it was necessary to divide the posterior part of the capsular ligament together with the muscles covering it there, namely, the obturator internus and the gemelli (the obturator externus and quadratus were previously cut across); and when the head of the femur was in that position, i.e. lodged on the pyriformis and at the edge of the sciatic notch, the limb was diminished in length by upwards of two inches. Now the statements of all observers agree in this, viz. that the shortening of the limb which attends the dislocation backwards (to the sciatic notch, as it is usually called), is less than an inch,—"from half an inch to an inch .... but generally not more than half an inch," according to Sir A. Cooper. But this alteration of the length is exactly what is found when the head of the femur is lodged behind the acetabulum, in the position noticed in Billard's case and mine, probably also in Dr. Scott's; while, on the contrary, it differs materially from that which would accompany the displacement of the bone into the place assigned to it in the work on Dislocations and Fractures of the Joints.

Proceeding now to the condition of the other structures immediately concerned in the dislocation:—The muscles most affected are those named the external rotators of the femur. Some variety was observed in the state of these muscles in the different cases, as the following plan will show:—

| | Scott. | Billard. | Quain. |
|---|---|---|---|
| Pyriformis and obturator internus | Entire. | Entire. | Entire. |
| Gemelli . . . . . | Ruptured. | Ruptured. | Entire. |
| Obturator externus . . . . | Not stated. | Entire. | Ruptured. |
| Quadratus femoris . . . . . | Ruptured. | Entire. | Ruptured. |

parts, to mark the spines of the ilia with such accuracy as to determine small degrees of difference between the limbs. When assistance is at hand, I have found it best to mark the pelvic prominences with the forefingers of both hands at the same time, while an assistant measures from these to the lower edges of the internal malleoli. But in the experiments on the dead body, after dividing the integuments over the bones, I fixed a nail into the spine of the iliac bone, and another into the edge of the malleolus. The space between these points was then measured before and after the dislocation was effected.

From the circumstance of the femur being moved backwards in the dislocation, the psoas, iliacus and pectineus muscles are perhaps necessarily in a state of tension. They are stated to have been found so by Billard. For the same reason the posterior parts of the two smaller gluteal muscles are in a state of relaxation.

The capsular ligament was torn at nearly the same part in Dr. Scott's case and mine—at the inner and upper part in the former, the inner and lower part in the latter. The condition of the structure is not mentioned by Billard, but, considering that the obturator internus was uninjured, it is reasonable to conclude that in this instance, as in the others, the capsule was entire at its posterior aspect. The ligamentum teres was torn in all the cases.

Looking to the state of the capsular ligament in this dislocation, it seems to me that the head of the femur leaves the acetabulum towards the inner or the lower part of the cavity, and turns from below, backwards and upwards, to reach the position which appears to belong to the dislocation. Moreover, the place at which the bone rests is materially influenced by the condition of the capsule; for, if the posterior part of this structure should not be torn through, the femur will not reach the sciatic notch; and the small muscles about the joint—obturators, gemelli, and quadratus—have the same effect.* (See ante, the experiments on the dead body.)

The connection of the great sciatic nerve with the dislocation is not devoid of interest. It was found to turn over the neck of the femur, coming into contact with the bone between the ends of the ruptured quadratus muscle, in the case of Coghlan detailed at the head of this paper (see the drawing): and it is highly probable that in Billard's case, though no mention is made of the fact, the nerve was likewise behind the same part of the femur; for the quadratus muscle, un-

* In a case of dislocation recorded by Mr. Todd, the head of the femur being lodged over the back part of the gluteus medius, all the small muscles, viz., "the pyriformis, gemini, obturatores, and quadratus," were completely torn across.—Dublin Hospital Reports, vol. iii. p. 395.

broken, occupied this position with reference to the bone; and in the natural state of parts the nerve is behind that muscle.

A circumstance observed in the treatment of a case of this form of dislocation may be here noticed, because it seems explicable only by reference to the position of the nerve. The patient (Horan, whose case will be afterwards detailed) stated that he suffered, and he appeared to suffer, much pain when his limb was moved, and even when it lay stationary on his bed; so much so, indeed, that taking the suffering he complained of in connection with his inability to evacuate his urine before the dislocation was reduced, I feared that he had sustained some injury of the trunk or of organs within the abdomen. But when the traction of the limb with the pulleys was begun, the countenance of this patient lost the expression of anguish it previously bore, and on being questioned he said that the pain was relieved by the pulling. It seemed to me that the relief experienced by this person might be explained by supposing the femur and the weight of the limb to be withdrawn from the sciatic nerve, the relative position of both structures (the bone and nerve) being the same as in the cases above referred to.

In Dr. Scott's case, however, the nerve is said to have been in front of the little cavity in which the head of the femur had been temporarily lodged; and it is also stated that, before the bone was replaced, "every attempt at rotation outwardly caused extreme pain in the groin, at the hip, and in the course of the sciatic nerve." These facts, especially the latter, would lead to the conclusion that, in this instance, the nerve was between the head of the femur and the pelvic bone. In the same situation was it found by Mr. Wormald, in a case before alluded to.*

The great nerve then, it is manifest, is always close to the neck or to the head of the femur in the dislocation backwards; but it may be either over or under [behind or in front of] the bone.

* Ante, p. 344.

2nd. So far respecting the anatomical history of the parts immediately concerned: the signs of the dislocation are next to be considered. Into this subject some inquiry becomes necessary, in consequence of a few points of difference between the external appearances of the limb, as observed in the case of Coghlan,* and the generally received account of those that characterize the displacement. The peculiar extent of the shortening of the limb; its inversion; the direction of the femur; the situation of the two great prominences at the upper end of that bone, viz. the trochanter and the head, together with the fulness behind the former prominence—these indications are the same in all the cases. The points of difference have reference to the direction of the dislocated thigh and the position of the foot.

"The knee," says Sir A. Cooper, "is not so much advanced as in the dislocation upwards, but is still brought a little more forwards than the other; . . . . the toe rests against the ball of the great toe of the other foot." According to Dr. Scott's report of the case he had observed, "the thigh lay very awkwardly upon the other;" and when the patient was "lifted out of bed and placed erect, the limb retained the position above described; the toes . . . . . lay above the opposite instep." The dislocated thigh is described by Billard to be slightly inclined towards the trunk, and the position of the limb such, that, to use his own words, "le genou droit chevauche sur le genou gauche." The foot is not mentioned by this observer; but it might be inferred from the direction of the thigh, which, in a great measure, determines the position of the lower part of the limb, that the foot must have been placed somewhat as it is said to be in the preceding extracts. In the case of Coghlan, however,† the dislocated thigh, instead of being inclined towards the trunk, or in advance of the sound limb, was actually further back than it; and the foot of the same side, though directed towards the opposite foot, as a part of the general inversion of the limb, was at some distance from it. The question therefore arises—Is that

* Ante, p. 340. † Ibid.

case to be considered altogether exceptional in these respects? To assist in the reply to this question I will refer to a case which occurred in my practice at the hospital.

John Horan, æt. 47, a middle-sized and rather muscular man, was admitted April 3rd, 1847. He stated that, being engaged in driving a large empty brick-cart, and standing on one of the shafts, a wheel having suddenly struck against a post, he was jerked forwards on his belly upon the horse, and then slipped to the ground head foremost. While he lay prone on the road, one of the wheels of the cart passed over his loins and the back of his right thigh to the outer side of the knee, the course it took being marked by ecchymosis and slight excoriation. He is not able to give any more detailed account of the position of the limb when the wheel struck him.

When placed upon his bed at the hospital, Horan lay on his back, but inclined to the sound side. The right lower limb was inverted, the inner side of the leg and foot being flat on the bed at the distance of some inches from the left limb, towards which the patella and the toes were directed. The length of the dislocated limb was about an inch less than that of the uninjured one. The outline of the femur being followed upwards with the eye, which was easily done, the bone appeared to be behind its natural position; and the trochanter seemed to be separated by more than the usual distance from the spine of the ilium. The head of the same bone was obscurely felt at first, but it became more distinct by slight rotation of the limb inwards. It was situated behind the trochanter and lower than that process, far back upon the pelvis, close to the upper end of the fold of the nates. Doubtless from this change in the position of the femur the thigh was altered in shape, the alteration consisting in an augmentation of its depth from before backwards, and apparently a decrease of breadth. When the affected limb was raised and placed in contact with the sound one the patient complained of pain, as indeed he did whenever it was moved; and the new position seemed to

cause so much suffering that the leg was again laid upon the bed, resting on its inner side.

The patient being then raised from bed and supported in the erect position, the displaced limb was observed to hang still at some distance from its fellow,* and further back than it—certainly not in advance of it. The toes rested on the ground. While he was in the same position I moved the foot inwards, and made the toes to rest on the other foot; but this movement, and the retention of the foot in the new position, were attended with an increase of pain.

To the preceding statement of the signs of the displacement may be added some evidence as to its nature of a different kind. During the efforts to restore the femur to the acetabulum the patient experienced decided relief from pain, which before that was constant. Of this fact mention has been already made, and its probable cause has been adverted to in the observations on the sciatic nerve.† Subsequently, also, to the reduction of the dislocation (on the day after), I found that on manipulating the dorsum of the ilium, no uneasiness was felt by the patient; but he complained of pain when moderate pressure was made at the back part of the pelvis, in the depression behind the great trochanter of the femur; and the pain was greatest behind the top of that prominence. The various facts now detailed leave, I think, no doubt that this was an example of dislocation backwards, as that dislocation has been described in the preceding part of this paper. And since, in this case, as well as in that of Coghlan, while unerring signs of the nature of the displacement were present, others usually stated to be characteristic of it, namely, the advanced position of the thigh and the lodgment of the foot upon the opposite one, were altogether

* I observed in another case of the same dislocation, which occurred in a young boy, that the leg on the injured side hung in the same manner away from its fellow, when the little patient was raised from bed; but when he lay down, the flexed position of the limb in close contact with the sound one was most agreeable to him.

† Ante, p. 346, 7.

wanting, it must be concluded that though these signs, when present, have their value in the diagnosis, their absence is by no means to be considered a proof of the non-existence of the dislocation they are taken to indicate.

3rd. *Reduction of the dislocation.*—Sir A. Cooper, in the rules he lays down respecting the means of effecting this object, states that, when the extending force is to be applied, "the thigh is to be brought across the middle of the other thigh." Acting on this rule, I began the extension in the direction here laid down in two cases—that of Horan and that of a little boy æt. 8,* whose limb had been dislocated about sixteen hours; but, in consequence of circumstances to be presently noticed, I soon changed the direction so as to bring the thigh forward to a right angle with the trunk.† After this alteration the head of the bone, in each of the two cases, speedily returned to the acetabulum. The circumstances by which I was led to place the limb in the position just indicated were these:—While making the experiments on the dead body, which have been before alluded to, I observed that, as the thigh was bent towards the abdomen, the head of the femur was brought nearer to the lower part of the acetabulum, where the capsular ligament was divided. To this it should be added that, in the bent position several muscles must be in a state of diminished tension; viz. the psoas, iliacus and pectineus, with, to a certain extent, the pyriformis, and the other so-named external rotators of the thigh. Be this, however, as it may, this important point remains, namely, that the restoration of the femur to the acetabulum was effected the more easily in proportion as the thigh was approximated to the abdomen.‡

* Ante, p. 350, note.

† In order to make the alteration in the relative direction of the limb and the trunk of the patient, it is not necessary to change the pulley or the perineal cloth. It will be sufficient to alter the direction of the body by turning the mattrass on which it is laid.

‡ After extension has been carried to a certain degree, rotation of the limb outwards is required, on the dead body, in order to turn the head of the femur in the opposite direction towards the acetabulum; but in the

It is likewise advantageous that, while the extension is being made, the thigh should be in a state of abduction, so that the head of the femur shall be drawn in a degree away from the side of the pelvis. With the view of effecting this object the pulleys were, in each of the two cases of dislocation before mentioned, fixed at a point higher than the patient's body, which was laid in the usual position for the reduction of the dislocation, viz. on the sound side. I was led to adopt this plan by observing the facility it gave me in reducing the dislocation on the dead body.

Sir A. Cooper, it will be remembered, advises that the upper part of the thigh should be drawn away from the side of the pelvis while the extension is carried on. "Whilst this [the extension with pulleys] is in progress, an assistant pulls the napkin [previously adjusted beneath the limb] at the upper part of the thigh with one hand, rests the other upon the brim of the pelvis, and thus lifts the bone, as it is drawn towards the acetabulum, over its lip." My own observation has led me to the conclusion that the object to be obtained in this part of the operation is, not only to prevent the head of the femur from being drawn against or along the pelvic bone, but also, to give space or opportunity for that rotation of the thigh bone, by which its head is turned forward beneath the trochanter to its natural situation. For this purpose I have, in several experiments, found the abduction of the thigh, as above suggested, the most effectual means; but there is no reason why the plan of Sir A. Cooper should not be used at the same time; and the combination of the two expedients might perhaps be resorted to with advantage in some difficult cases.

It will not be irrelevant to mention, in concluding this part of the subject, that the plan of fixing the pulleys to the thigh above the knee which is commonly practised, but without, I believe, any other reason for its adoption than that of

living person a "spontaneous evolution" of the limb is, as it is generally known, effected through the agency of the muscles, and by means of this the femur is wheeled into its place.

convenience, is important on other grounds in reducing the dislocation backwards. The reason is this: when the knee is straight the great sciatic nerve is extended, but when the joint is bent, the same structure is in the opposite state, loose; and I have repeatedly observed that the great nerve is much stretched during the extension of the limb, when made from a point below the knee. This observation applies, whatever the position of the nerve may be, but most strikingly when it happens to be above the neck of the femur.

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The inferences to be deduced from the foregoing observations may be summed up as follows:—

In the ordinary form of the dislocation backwards, the femur does not reach the sciatic notch.

The head of that bone is lodged immediately behind the acetabulum, over the base of the ischiatic spine and opposite to a small part of each of the two sacro-sciatic foramina.

The advanced position of the displaced limb at the knee, and the situation of the foot, "the toe resting against the great toe of the other foot," are not necessarily present in this dislocation.

During the extension made to restore the bone to its place, the thigh is most advantageously directed across the pelvis, so that it shall form a right angle, or nearly a right angle, with the abdomen.

At the same time the limb is to be in a state of abduction. The femur is thus drawn away from the pelvis forwards and outwards.

And the knee is to be bent, the extending force being fixed above this joint.

To prevent misapprehension it may be well to state, in conclusion, that certain cases, mentioned in the preceding pages, exemplify important modifications of the most fre-

quent form of the displacement of the femur "backwards," which it has been the purpose of this paper to illustrate. Thus, the case observed by Sir A. Cooper, and that by Mr. Todd, should be regarded as instances of dislocation "backwards and upwards," but in different degrees. While, on the other hand, Mr. Wormald's case should, in strictness, be considered an example of the dislocation "backwards and downwards;" it being understood, however, to deviate but slightly from the usual form of the injury.

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## EXPLANATION OF PLATE V.;

Exhibiting dislocation of the head of the right femur, backwards.

*a*. Head of the bone.
*b*. Large trochanter.
*c*. Small trochanter.
*d*. Sacrum.
*e*. Tuberosity of ischium.
*f*. Lower end of gluteus maximus.
*g*. Gluteus medius.
*h*. Pyriformis.
*k*. Obturator internus, and gemelli.
*l*. A fragment of obturator externus.
*m*. Quadratus femoris.
*n*. Hamstring muscles.
*o*. Long sacro-sciatic ligament.
*p*. Great sciatic nerve.
*q*. Small sciatic nerve.
*r*. Sciatic artery.

PLATE V

Drawn by Noah Brangwin Esq.

B. George, lith. 54, Hatton Garden.

ON THE

# MOVEMENTS OF RESPIRATION IN DISEASE,

AND ON

## THE USE OF A CHEST-MEASURER.

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Communicated by Dr. HODGKIN.

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The incomparable Laennec says, "L'inspection du thorax pendant la respiration est très peu utile." Well did Dr. Forbes remark, in translating this passage, that Laennec underrated the inspection of the motions of the chest as a means of diagnosis.

Notwithstanding this opinion of Laennec, almost all the principal subsequent authors on the diseases of the chest, such as, among others, Andral, Collin, Dr. Forbes, Dr. C. J. B. Williams, Sir James Clark, Dr. Stokes, M. Voilliez, M. Fournet, Dr. Watson, and Dr. Walshe, have successively investigated the respiratory movements in chest disease. There has been indeed, of late years, a growing sense of the importance of observing the motions of respiration in forming a diagnosis.

Impressed with the importance of the inquiry, and desirous of ascertaining the true value of the phenomena in diagnosis, I have for some years investigated the movements of respiration in health and disease. Many of my observations on this subject were published in 1844 in the Transactions of the Provincial Medical and Surgical Association, in a paper on "The Changes in the Situation of the Internal Organs;" and in

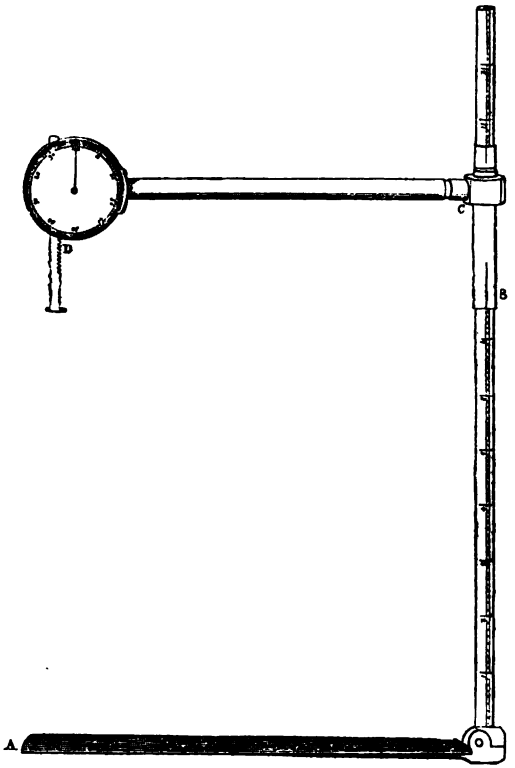
1846, in the Philosophical Transactions, in a paper "On the Mechanism of Respiration," which treated of the anatomy and movements of the breathing apparatus in man and other animals supplied with lungs.

In pursuing the researches comprised in those papers, I found the want of an instrument for accurately and minutely measuring the movements of respiration. About two years ago, I succeeded, with the assistance of a patient in the Nottingham Hospital, and finally of Mr. Simmonds, in completing such an instrument. It is a *Chest-Measurer*, measuring the diameter of the chest, and indicating by the motion of the index on a dial any movement of respiration to the hundredth of an inch. It is in fact a micrometer of motion. It can be readily applied to any part of the body, and by successive applications of it over the chest and abdomen, all the movements of respiration can be ascertained with minute accuracy. The character as well as the extent of motion may be read off from the dial. It indicates the rythm of respiration, showing whether the expiration be equal to, longer, or shorter than, the inspiration.

The chest-measurer shows the exact amount of chest movement, both during tranquil breathing and the deepest possible inspiration and expiration. It thus tells indirectly the extreme breathing-capacity of the chest, which is rendered perfectly by the "spirometer" with which Dr. Hutchinson has made so many valuable observations. In this respect it is indeed a "pocket spirometer."

To assist in the inquiry into the movements of respiration, I have made diagrams from the dead—in health and in disease—of the position of the ribs and internal organs, both before and after the complete inflation of the lungs. I traced the outlines of the organs with chalk on a piece of black lace, stretched on a frame, and placed over the body. I transferred these outlines to paper, and reduced them by a pentagraph. The tracing-frame and the pentagraph were the suggestion of my friend Dr. Hodgkin. Engravings from these diagrams were published, in the papers referred to above, in

the Provincial Medical and Surgical, and the Philosophical, Transactions, and very recently in the Medical Gazette.




THE CHEST-MEASURER.

A. Brass plate, covered with silk, on which the patient lies (see the figure at p. 364).

B. Upright rod, divided into inches and tenths, to indicate, by the slide at B, the diameter of the chest.

C. B. Slide, moving on the vertical rod B, and carrying the horizontal rod and dial C. D.

C. D. Horizontal rod, dial and rack (D). This rod can be drawn out like a telescope from C—an outer rod sliding on an inner; and as the outer rod can be rotated on the inner, the inclination of the rack and dial can be varied at will, by the finger and thumb. This combination of slides forms a universal joint (see fig. at p. 364).

D. Rack and dial. The rack, when raised by the moving walls of the chest, moves, by means of a pinion, the index on the dial. One revolution of the index indicates an inch of motion in the chest; each division indicates the 100th of an inch.

The Chest-measurer packs into a pocket case.

Mr. Kaim, of this town, has taken for me the daguerreotypes which accompany this paper. The outlines of the organs in the tranquil state, and during the deepest possible inspiration, were previously traced on the skin. Two successive daguerreotypes were taken from each person, one showing the form of the chest, and the position of the organs in the tranquil state; the other showing the changes produced when the lungs were expanded to the full.

## PART I.—ON THE MOVEMENTS OF RESPIRATION IN HEALTH.

We cannot of course recognise the respiratory movements in disease, unless we know what they should be in health. I shall, therefore, detail what I have observed to be those movements in health.

The materials for the inquiry consist in the diagrams above referred to; tabulated observations of the position of the thoracic viscera in the tranquil state, and during a deep inspiration, in eighty persons, of both sexes and various ages, in whom the lungs and heart were healthy; and tabulated observations made with the chest-measurer, of the movements of the ribs and abdomen in fifty-seven persons free from organic disease. In many of these the capacity of the lungs was ascertained by the spirometer.*

In health, every part of the chest expands during each inspiration, whether the breathing be tranquil or exaggerated.

The costal motion in tranquil breathing is, in the robust man, exceedingly small. In a man whose chest was the finest in development I have seen, and who stands third among English runners (Westall, Case 12 in Table I.), the

* See the annexed Table I. In all the persons included in this table, the internal organs were, after careful examination, considered to be healthy. The majority of them were surgical and medical patients in the Nottingham General Hospital. I had two reasons for preferring such persons to those in perfect health; firstly, they were completely at my command; and, secondly, they were more nearly allied, in general health, to those cases of chest-disease with which they were to be compared, but from which they differed in this—that their internal organs were healthy.

motion of the second rib, taken in the sitting posture, was, in tranquil breathing, ·03 to ·05 of an inch, while during the deepest possible inspiration it moved forwards 2·25 inches. Here the motion of the second rib was forty-five times greater when the chest was expanded to the full than it was in tranquil breathing. This man was about 5 ft. 9 in. in height; his weight was about 12 stone; he expelled 290 cubic inches at one expiration, and the greatest inspiratory expansion of the circumference of his chest was 5½ inches.

In this person, slight as were the costal movements during tranquil breathing, they were yet quite palpable over every part of the chest examined.

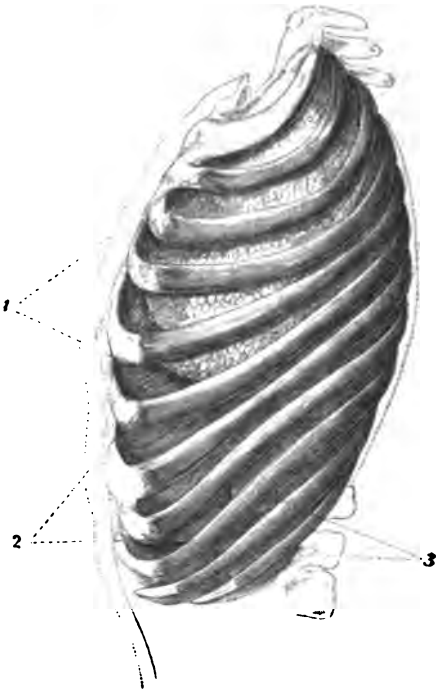
Dr. Hutchinson says, in his paper on the Respiratory Functions, "This is supposing a costal motion, which I believe rarely exists." In every person I have yet examined I have found the costal movements to exist, whenever respiration has not been controlled by volition. By the aid of the chest-measurer, any one may verify this observation. Without this instrument the costal motion in tranquil breathing can be observed with difficulty.

*Division of the ribs into three sets,—thoracic, diaphragmatic, and intermediate.*

*Thoracic set of ribs, 1st, 2nd, 3rd, 4th and 5th.*—See the figure at the next page.—The lower margin of the right lung, and the lower boundary of the heart, are anteriorly just above the sixth costal cartilages. In front, the lungs and heart lie wholly behind the sternum and the five superior ribs, which I have termed, in the paper on the Mechanism of Respiration, THE THORACIC SET OF RIBS, and which form in front the true thorax. The motion of the thoracic set of ribs expands the superior and middle lobes. To the side, the lower margins of the lungs, as they spread outwards, pass successively within the sixth, seventh, eighth, ninth, tenth and eleventh ribs.

*Diaphragmatic set of ribs, 9th, 10th, 11th, and 12th.*—The ninth, tenth, eleventh and twelfth ribs protect the

lower and back part of the lungs, and, in great part, the liver, stomach and spleen. They give origin to the diaphragm, and when the diaphragm acts they move outwards and backwards to expand the lower and back part of the lung, and they form the *diaphragmatic set* of ribs.




1. The Thoracic set of ribs.
2. The Intermediate set of ribs.
3. The Diaphragmatic set of ribs. The left lung, the heart, stomach, spleen, and left kidney, are seen through the intercostal spaces.

The dotted lines indicate the outlines of the chest when the lungs are fully inflated (as they are during a deep inspiration).

*Intermediate set of ribs, 6th, 7th and 8th.*—The sixth, seventh and eighth ribs are both diaphragmatic and thoracic in their position and action; they form the *intermediate set*, and

expand the upper portion of the lower lobe, and, on the descent of it, the lower portion of the upper lobe.

The division of the ribs into the three sets of thoracic, diaphragmatic, and intermediate, which I proposed on anatomical grounds, I find of practical value in the diagnosis of disease, as I shall have to state more fully hereafter. The important practical point to bear in mind with regard to the respiratory movement of the different sets of ribs is, the portion of lung that each set expands.

During a deep inspiration, the anterior portions of the ribs move forwards and upwards, and through the intervention of their cartilages carry forwards and upwards the sternum; while the posterior portions of the ribs move backwards, and push backwards the dorsal column.

The dorsal vertebræ form an arch, and as the ribs of the intermediate set, the sixth, seventh and eighth, are longer than those of the thoracic set, they thrust backwards the middle of the dorsal arch further than those of the thoracic set push backwards the upper part of the arch; the dorsal arch is consequently deepened, and, therefore, shortened.

The shortening of the dorsal arch, and consequent lowering of the head, during each involuntary inspiration, is very manifest to the eye in persons, especially in females, lying on the side, suffering from dyspnœa.*

* Dr. Hutchinson says (Med.-Chir. Transactions, vol. xxix. p. 191), "The head is protruded and lowered in the deep expiration," "raised and thrown back in the deep inspiration." I am satisfied that this is accurate as applied to those he observed, who were examined when erect, and who were desired to expire and inspire deeply; as they were erect the straightening and lengthening of the lumbar curve counteracted the deepening and shortening of the dorsal curve. Besides this, their breathing was voluntary. They elevated the head with one set of muscles, while they expanded the chest with another. One thing is certain, that in the erect posture, although healthy men usually raise the head when they take a deep voluntary inspiration; yet women in tight stays, whose breathing is markedly costal, and persons affected with emphysema, lower their heads when they inspire involuntarily to the extent of ·01 to ·02 in. When I take a deep inspiration, I can either elevate the head ·50 in. or lower it ·40 in., or keep it perfectly still, so much

Each of the four or five superior ribs (the thoracic set) ascends during inspiration more than the rib above it; they consequently then move nearer to each other; while the diaphragmatic and intermediate ribs move further apart. This, as I have shown in my paper on the Mechanism of Respiration, is in great part due to the articulation of the ribs with a moveable dorsal arch.*

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control has will over the movements of respiration. In the tranquil breathing of men, the shortening of the dorsal arch is imperceptible, their costal respiration being so trifling; but in females, it may usually be observed. It follows from these observations, which can be readily verified, that Dr. Hutchinson's remark, that "The body is lowered or shortened in expiration," must be qualified; as in the instances I have mentioned, the body was then markedly lengthened. During voluntary deep expiration, and during the act of coughing, the body is markedly shortened, as then the powerful abdominal muscles pull downwards and forwards the sternum and ribs, and, through them, bend forward the lumbar vertebræ.

* Dr. Hutchinson says, p. 215, "In inspiration the ribs diverge from each other, in expiration they converge towards each other." This statement, correct as regards reptiles and birds, requires to be qualified in regard to man, and the mammalia who possess, like man, a dorsal arch. It may be easily observed on a thin person by placing one finger on the third and another on the first rib, that they converge during inspiration, while, by adopting the same plan, from the seventh to the twelfth, it will be found that they diverge. The divergence of the diaphragmatic ribs is very great, and it is in part owing to their great divergence that the action of the middle parts of the tenth and eleventh external intercostals is expiratory; while it is owing to the great convergence of the upper ribs that the internal intercostals between the first and the third ribs are inspiratory, thus reversing in each instance the natural action of those muscles, the former of which is in the bird and reptile throughout inspiratory, and the latter throughout expiratory. I beg to refer on this interesting subject to the plates and description in the paper on the Mechanism of Respiration.

*Postscript, August* 1848.—It is interesting to notice that these views, which I hope to have an early opportunity of demonstrating, account for and reconcile the different views of the action of the intercostals, held by the great physiologists of the last century, who occupied themselves so warmly in what may be termed the battle of the intercostals.

Hamberger constructed a machine representing the sternum, the vertebræ, and two ribs, with threads interposed to imitate the external and internal intercostals and the inter-cartilaginous muscles. From this he inferred that the external intercostals are all inspiratory—the internal

While the thoracic set of ribs approach each other, their cartilages ascend and the inter-cartilaginous portions of their internal intercostal muscles act during inspiration.*

all expiratory, and that the inter-cartilaginous muscles are inspiratory. —(Haller de Respiratione. Opuscula Anatomica, pp. 50. 92.)

Of this machine, Haller says, "Ponit nimirum CL. AUCTOR machinæ suæ costam utramque æque mobilem esse. Sed hujus modicostas DEUS nobis non dedit."

In opposition to Hamberger, Haller observed that he had overlooked, among other things, the difference of mobility in different ribs—the second rib being five times more moveable than the first, and so on; and he showed, from experiment, that during extreme inspiration the space between the first and second ribs diminished from ·85 in. to ·63 in.; and on extreme expiration it again increased from ·63 to ·89 (p. 52). He also showed that the ribs rotated on themselves, the lower edge moving outwards (p. 126). That the external intercostal and the inter-cartilaginous muscles were inspiratory, he agreed with Hamberger; but he differed altogether with regard to the internal intercostals, which he observed to be inspiratory in the superior intercostal spaces, especially in the first, in many experiments carefully conducted. He noticed that, below, the internal intercostals scarcely acted; but he laid it down as a rule that the internal and external intercostals combine to expand the chest during inspiration, thus agreeing with Mayow.

In this controversy both were right and both were wrong. Each was right in what he observed; but he did not observe the whole of the complex respiratory apparatus. Hamberger was right as to the lower ribs, for they diverge during inspiration. Haller as to the upper ribs, for they then converge. Hamberger, with Bayle, Fabricius, and Hoadley, was right in part, as to the separate functions of the outer and inner intercostals, the external being inspiratory, the internal expiratory throughout, behind and between the intermediate and adjoining ribs, at the side in man and the other mammalia, and throughout in reptiles. Haller was right in stating that the internal and external intercostals acted together in the upper intercostal spaces.

Dr. Reid, in an admirable article on respiration (Cyclopædia of Anatomy and Physiology, vol. iv. p. 333), says, the two lower ribs descend during inspiration. I observe that the lowest is stationary, the eleventh ascends, and both move backwards. From this relative motion of the two lowest ribs, whether on Dr. Reid's view or mine, the lowest external intercostal must be expiratory.

I imagine that Dr. Hutchinson's machine (which is like diagrams in Hoadley's, Bernoulli's and Monroe's works, and in my own paper) resembles Hamberger's, and that, like Hamberger, in acknowledging partial truth he has been led into partial error.

* "The cartilaginous portions" "of the second, third, fourth, and fifth

The movements that take place during a deep inspiration are these:—the scapulæ are raised; the anterior portions of the ribs, the sternum and the clavicles move forwards; the posterior portions of the ribs and the dorsal and lumbar vertebræ move backwards; the sternum and the dorsal arch become, both of them, more curved; the third, fourth and fifth costal cartilages at each side of the sternum advance more than the sternum, and the anterior prominences formed by those cartilages become fuller; the angles of the ribs move backwards more than the spine, and the deep space formed for the lung to each side of the spine increases in depth; the ribs expand laterally to a great but varying extent, the diaphragm descends, and the abdomen protrudes considerably, often more than an inch.

These movements of thoracic expansion are necessarily attended by the expansion and descent of the lungs and heart, and the compression and descent of the liver, spleen and stomach, and all the abdominal and pelvic viscera.

The lungs of course spread wherever the space is increased for them. The bulk of the upper portions of the lungs is in front, and of the lower portions behind; and, in conformity with this arrangement, the inspiratory movements of the superior ribs, or the thoracic set, is chiefly forwards and upwards, while that of the inferior or diaphragmatic set is chiefly backwards, (see the dotted lines in the figure at page 364, which indicate the thoracic expansion anteriorly and posteriorly,) the lower ribs not ascending so much as the upper, and the lowest of all having scarcely any ascending motion.

The diaphragm, in its descent during a deep inspiration, first flattens its own convexity, especially on the right side, and then descends from an inch to an inch and a half. It, consequently, lessens the concavity at the base of each lung,

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ribs" "are, during inspiration, raised and brought nearer to each other by the contraction of the sternal and inter-cartilaginous portions of the deep intercostal muscles."—The Author, on the Changes in the Situation of the Internal Organs. Provincial Medical Trans., vol. xii. p. 354.

especially the right, and draws down the whole base of each lung; in front, the right base descends from the lower end of the sternum to the lower end of the xyphoid cartilage, and both bases descend from the sixth costal cartilages to the seventh. At the side and behind, the descent is in the same proportion. The contraction of the central muscular fibres of the diaphragm draws down its central tendon from three-quarters of an inch to an inch. The heart is necessarily drawn downwards to the same extent; while the lungs spread into the space previously occupied by the heart, and cover it to an increased extent, so that the exposed portion of it is diminished. The heart is now shielded by the left lung at the fourth and fifth intercostal spaces, and its impulse is no longer felt there, but it is felt, instead, behind, below, and to the left of, the xyphoid cartilage.

While the descent of the diaphragm lengthens the thorax it compresses the abdomen. The liver, stomach, spleen, pancreas, kidneys, and all the abdominal organs, the uterus (the inspiratory descent of which has been felt by Dr. Frederick Bird), and all the pelvic viscera, are pushed downwards during a deep inspiration; at which time the perinæum protrudes more than it does in the tranquil state.

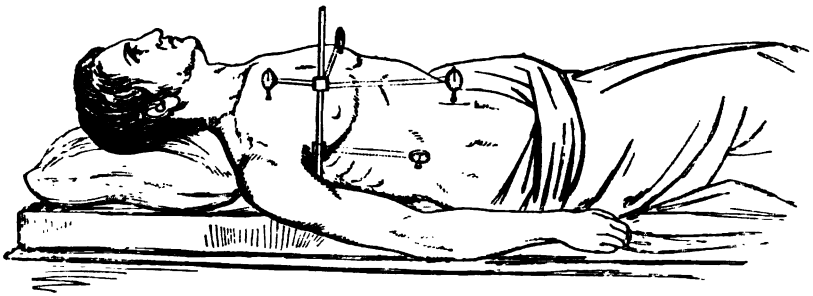
These inspiratory movements of the diaphragm have doubtless an important physiological action on the abdominal organs in thus displacing and compressing them. The blood, which accumulates during expiration in the solid viscera, is, during inspiration, drawn off, and the hollow viscera have their innate contractile force assisted.*

* Dr. Hutchinson says, op. cit., p. 187, "It appears to me a matter of doubt whether the diaphragm in the act of inspiration descends at all." This doubt has arisen from the falling in of *a part* of the abdomen during voluntary deep inspiration in the erect posture. In healthy persons when recumbent the abdomen between the xyphoid cartilage and the umbilicus moves forward, during an ordinary inspiration, ·3 in., and during a deep inspiration from ·5 in. to 1·5 in.

Any one may readily prove to himself the extensive descent of the diaphragm during a deep inspiration. Percuss over the lower margin of the right lung, ascertain its boundary, and mark it; desire the person to

### *On the Employment of the Chest-Measurer in Health.*

The immediate indications afforded by the chest-measurer in health, must be considered during ordinary involuntary respiration, and during the deepest voluntary respiration.



CHEST-MEASURER APPLIED.

By placing the instrument in the manner here represented, the patient lying on the flat plate forming the basis of the instrument (see fig. at p. 355), the rack and dial, by a little adjustment, can be successively applied over the various parts of the chest and abdomen, without disturbing the patient.

The patient should be desired to look at the ceiling, that his attention may not be directed to the dial, by watching which his inspiratory movements are inevitably disturbed.

The instrument should be steadied by the hand holding the slide carrying the rod and dial, the finger and thumb having hold of the outer rotating tube of the horizontal rod (see fig. at p. 355).

To make a complete examination, the rack and dial may be successively applied over the different parts of the chest and abdomen, in the manner detailed in the note in the opposite page.

In almost all cases I employed the chest-measurer when the patient was lying on the back, perfectly straight, in bed. The instrument was thus perfectly steadied by the patient, lying on the horizontal flat plate that forms its basis: the

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take a deep breath, and hold it; then percuss downwards, and the hepatic dulness will be replaced by pulmonic resonance to the extent, in the adult, of an inch or an inch and a half. Notice the seat of the heart's impulse, first during ordinary breathing, and then during a deep inspiration; it will be displaced from the intercostal spaces, and will be felt behind or even below the xyphoid cartilage,—a manifest proof that the extensive descent of the central tendon of the diaphragm draws own the

whole antero-posterior motion was conveyed to the index on the dial; and the examination was made in the manner usually most convenient, especially in hospital practice. It mattered little, however, whether the recumbent or sitting posture was adopted, so long as all the observations were made in the same manner.*

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heart. Notice the forward movement of the abdomen between the xyphoid cartilage and the umbilicus during a deep inspiration both in the recumbent and the erect posture; taking care not to be led astray by the irregular and volitionary play of the abdominal muscles that often takes place, especially when the person is erect.

No other proof of the descent of the diaphragm during a deep inspiration is needed than the inspection of Dr. Hutchinson's own accurate silhouettes, p. 186, 191. In diagram 16, p. 191, the abdominal organs from the ensiform cartilage to within a shade of the umbilicus are considerably more prominent during a deep inspiration than in the tranquil state, and they are everywhere more prominent than they are during a deep expiration.

* To observe the motion of the sternum and the thoracic set of ribs, and the expansion of the upper lobes, the middle lobe of the right lung, and the heart, I applied the instrument successively to the upper and lower end of the principal bones of the sternum, to the second rib, and to the fourth or fifth costal cartilage within and below the nipple;—to ascertain the motion of the intermediate ribs, and the expansion of the upper portion and bulk of the lower lobe and the lower portion of the upper, it was placed over the sixth rib in front and to the side, and the eighth ribs to the side;—to discover the motion of the diaphragmatic set of ribs, and the expansion of the lower portion of the lower lobe, and the displacement of the abdominal organs through diaphragmatic breathing, it was applied over the tenth ribs. Finally, it was applied to the abdomen in the centre, between the lower end of the sternum and the umbilicus, and at each side, to ascertain the motion of the diaphragm.

After taking these observations successively, and in the latter cases simultaneously on the two sides with two chest-measurers, I repeated them all, after desiring the patient during each observation to take as deep a breath as possible, and blow out as far as he could.

I then took the actual diameter of the chest from dorsum to sternum, and from side to side, at the fifth, eighth, and tenth ribs.

I also measured each side, at various places, with tape, from sternum to dorsum, observing the mobility of the ribs during the deepest possible inspiration and expiration.

Finally, the number of respirations in the minute, the extreme capacity of the chest, as tested by the spirometer, and the height and weight, were taken.

I also described the form of the chest, and its surfaces, the position of

Many and various applications of the instrument, of course by no means required in actual practice, were adopted in my inquiry, with the view of bringing the subject of the respiratory movements in health and disease to the test of accurate and general observation.

*Motions observed by the Chest-Measurer during an Ordinary Inspiration.*

In robust healthy males from the age of 12 to 45, the motion of the first six ribs (the thoracic and the uppermost of the intermediate set) was found to be trifling, but still in every case and everywhere some slight motion existed.

The motion of the upper end of the long bone of the sternum is usually from ·02 to ·06 in.; that of the lower end is about the same. The motion of the upper end is often greater than that of the lower; but the reverse is sometimes the case. The motion of the second ribs near their costal cartilages is a little greater than that of the corresponding portion of the sternum. The sternum is, indeed, pushed forward by those ribs through the medium of their cartilages; but a part of the force is spent in slightly bending the cartilages, and consequently the forward motion of the second ribs is necessarily greater than that of the sternum; thus, while the movement of the sternum is from ·02 to ·06 in., that of the second rib is from ·03 to ·07 in.

The advance of the sixth costal cartilages usually corresponds to that of the lower end of the sternum, being from ·02 to ·06 in.

The movement of the fourth and fifth costal cartilages is usually scarcely equal to that of the second ribs.

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certain of the viscera, and the changes induced in the seat of them, and the heart's impulse during a deep inspiration. (These notes are in my possession, and are accessible to any one interested in the subject.)

It was necessarily only the healthy *males* that underwent all this examination, and indeed only a portion of them. The tables and the cases in the Appendix will tell which were complete and which incomplete, as far as regards their examination.

The lateral expansion of the sixth rib is in almost all cases less than the forward motion of the sixth costal cartilage; but in this comparison the lateral expansion of each sixth rib is taken separately, while the whole forward movement over the sixth cartilage is observed from dorsum to sternum: the whole lateral expansion of the chest, from sixth rib to sixth rib, is equal to, or even greater than, the whole antero-posterior expansion of the chest over the sixth costal cartilage.

Owing to the presence of the heart, the motions of the left fourth, fifth and sixth cartilages, and the sixth rib, and indeed of all the left lower ribs, are less than those of the right; the difference being most usual and greatest over the fourth and fifth cartilages, and at the lateral expansion of the sixth rib.

The motions of the five superior or thoracic ribs are, with the exceptions stated, everywhere pretty nearly equal.

The lateral motions of the eighth and tenth ribs are almost invariably greater than those of the thoracic ribs and cartilages, so long as the breathing is quite tranquil, and the motion of the thoracic ribs small; the lateral expansion of the eighth and tenth ribs ranges usually from ·05 to ·1 in., while the motions of the thoracic ribs and cartilages vary from ·02 to ·05 in. It will be remarked, that if the motion of the thoracic ribs be greater than usual, say ·06 to ·1 in., the lateral motion of the eighth and tenth ribs is not increased, and then all the costal motions are nearly equal.*

There is very little difference between the exact motion of the ribs in healthy robust boys and in men, from the age of 10 upwards to 45. This rule does not, however, obtain with regard to the diaphragm; for while in man, during tranquil respiration, the advance of the centre of the abdomen between the xyphoid cartilage and the umbilicus is from ·25 to ·35 in., in boys and youths it is from ·2 to ·25 in.

The movements of the abdomen to each side is about the same in boys and men, being usually from ·08 to ·12. in.

* See Stevenson, Case 32, Table I.

It is manifest, from these observations, that in tranquil breathing diaphragmatic respiration far outweighs costal, in the proportion of about 30 to 5. It is also evident that the eighth and tenth ribs have a greater expansion than the thoracic ribs, owing to their action being auxiliary to that of the diaphragm.

*Respiratory Movements during the deepest Voluntary Inspiration.*

When a person takes as deep an inspiration as possible, the motion both of the ribs and diaphragm is everywhere much greater than during tranquil breathing, but the increased motion of the ribs is much greater than that of the diaphragm.

As I have stated above, the greatest observed difference between the motion of the second ribs during tranquil breathing and their motion during the deepest possible inspiration was in the runner ·05 in. and 2·25 in., or in the proportion of 1 to 45. This was, however, a man of unusual thoracic mobility and breathing-capacity, and his was in every respect an extreme case. The amount of increased motion evidently bears a ratio to the capacity of the lungs, and the mobility of the chest. Contrast the third of the following cases with the other two :—

| Number in Table. | Name. | Height. | Extreme capacity of lungs. | Motion of second rib during | |
|---|---|---|---|---|---|
| | | | | Tranquil breathing | Deepest insp. |
| | | Ft. In. | Cubic inches. | In. | In. |
| 17 | O'Connell . . . | 5 8¼ | 170 | ·03 to ·07 | ·50 |
| 6 | Nettleship . . . | 5 4¼ | 190 | ·02 to ·07 | ·50 |
| 12 | Westall, the runner | 5 8¼ | 290 | ·05 | 2·25 |

In all these cases I felt satisfied that there was no chest-disease.

The eye, on running down the columns of the respiratory movements in ordinary and exaggerated breathing in health

(Table I.), will observe that in some cases where the breathing-capacity is small, the extreme costal motion is considerable, while in others, where the capacity is great, the extreme costal motion is comparatively but little. I do not doubt, however, that, if a sufficient number of cases were collected, it would be found that the extreme respiratory motions, as indicated by the chest-measurer, will, as a general rule, agree with the sound and important conclusions to which Dr. Hutchinson has arrived with regard to the breathing-capacity and the influence upon it of height, mobility of chest, age, weight, and other circumstances.

One thing is certain, that the extreme range of motion may vary considerably in persons whose chest and general system are perfectly sound. This is, I take it, in great part due to the inability of many persons, when recumbent, to inspire and expire deeply when directed so to do. In practice we shall find that healthy persons when recumbent may have a range of extreme respiratory motion varying from one-half or three-quarters of an inch to about an inch and a half, or even two inches.

The various ribs have nearly the same amount of motion during extreme respiration, but the lateral motion of each rib is less than its anterior motion. The extent of motion of the diaphragm is about the same as that of the ribs, since it descends about an inch; and that of the abdomen, between the lower end of the sternum and the umbilicus, is also about an inch, sometimes more and sometimes less.

The motion of the lower or diaphragmatic ribs and the eighth rib, which in tranquil breathing is greater, is in extreme respiration less than that of the thoracic ribs.

Many persons in perfect visceral health, affected with pain or injury, or some peculiarity of constitution, have an ordinary costal expansion of ·08 to ·12 or ·14 in.: in such persons the diaphragmatic motion is from ·20 to ·25 in., and the motion of the diaphragmatic ribs and the eighth ribs, instead of being greater, is often only equal to or even less than that of the thoracic ribs. (Table, Cases 28—37.)

In one man—Clay—(Table I., Case 30)—who had suffered from sciatica, the breathing, instead of being natural, was rather a succession of irregular sighs about nine in the minute; the second ribs had during inspiration a motion varying from ·1 to ·2 in., the abdominal muscles (diaphragm) advanced ·9 in. to 1 in., and the eighth and diaphragmatic ribs moved outwards from ·3 to ·4 in. In extreme inspiration the second rib advanced 1 in., and the abdomen (diaphragm) 1·60 in.

*Respiratory Movements in Boyhood and Old Age.*

In boys the cartilages are more flexible, and the costal mobility is greater than in adults. The extreme costal motion is in them greater in proportion to their breathing-capacity than in adults. Thus in Coupe, (Table I., Case 25,) aged 11, whose height was 4 ft. 7½ in., and breathing-capacity only 110 cubic inches, the ordinary movement of the second rib was ·06 in. and the extreme movement 1·30. Some boys, especially if they have been long in bed, have very little command over their inspiratory muscles, and in them the extreme movement may be slight. In Greenfield, (Table I., Case 27,) for instance, a boy of 10 years of age, pale, having a diseased knee, but whose chest was healthy, the ordinary motion of the second rib was ·03 in., and sometimes 0, and the extreme motion ·3 in. Such boys, besides their irregular volition, are manifestly out of practice in the complete action of their ribs.

In old age (Table I., Cases 38–44) each cartilage is ossified, forming with the rib one unbending piece. The costal motion is carried on by the lateral anterior and posterior thrust of the solidified rib and cartilage; and in old men, owing to the non-yielding of the cartilages, the advance of the sternum, both during ordinary and extreme inspiration, is often greater than that of the second rib. In this respect old age differs remarkably from boyhood, when, owing to the great flexibility of the cartilages, the costal advance is greater than the sternal.

For the same reason, namely, the completion into one un-

yielding piece of the rib and cartilage in the aged, the lower end of the sternum, owing to the sixth and seventh ribs being longer than the second, usually advances more than the upper portion; while in youth, owing to the flexibility of the cartilages, the upper portion of the sternum usually advances more than the lower end.

In the aged, the lateral motion of the sixth rib is increased, during both ordinary and deep inspiration, while that of the diaphragmatic ribs is diminished.

The ordinary diaphragmatic breathing of the aged is rather above the average, being from ·3 to ·5 in., but its extreme movement is not remarkable.

The difference both in the ordinary and extreme respiratory movement of the left diaphragmatic and intermediate sets of ribs, as compared with the right, is usually more marked in old age than in youth.

In the adult period of life the younger man has more often those varieties of costal motion characteristic of the boy, and the older man more often those of old age.

*Influence of Height on the Respiratory Motions.*

Height has a perceptible influence on the extreme costal motion, following the important law laid down by Dr. Hutchinson, that the breathing-capacity increases with the height.

I feel convinced of the soundness of Dr. Hodgkin's view that the increased capacity with height is in great part due to the increased length of the dorsal portion of the spinal column. The long-bodied dwarf given by Dr. Hutchinson at p. 184 does not really militate against this view, as that man is evidently a deformity.

An additional reason for the greater capacity of the tall is, I conceive, the greater length of their ribs as well as of their other bones. If so, in the narrow-chested tall man of great breathing-capacity, the ribs will be more oblique than in a short man whose chest is of equal diameter but whose capacity of breathing is smaller. In such a case, the tall man will have a

greater range of motion of his ribs, just as he has of his thighs when he raises them.

*Respiratory Movements in the Healthy Female.*

In the adult female, the form of the chest and abdomen, and the respiratory movements, are often undoubtedly modified by tight lacing.

The form of the chest and the respiratory movements do not differ perceptibly in girls and boys below the age of 10. Although the form of the chest remains nearly the same until the age of 12, the abdominal movement is then somewhat less, and the thoracic, somewhat greater, in girls than boys. At this age, and earlier, stays are worn; and though they do not compress the body materially, yet they restrain the free expansion of the lower ribs during brisk exercise. After the age of 14 the form of the chest and the respiratory movements differ materially in females and males. The transverse diameter of the chest from seventh rib to seventh, instead of being greater than that from fifth rib to fifth, as it is in males, is in females considerably less. This difference is greater or less, in proportion as the stays are worn more or less tight. There is a great difference in the respiratory movements, when the stays are on, and when they are off. When they are on, the thoracic movement is very much exaggerated, the second ribs then moving forward from ·06 to ·2 in., while when they are off, they only move forward from ·03 to ·1 in. On the other hand, the movements of the lower ribs and diaphragm are much more restrained when the stays are on (the abdominal movement being then ·06 to ·11 in.), than when they are off (the abdominal movement being then from ·08 to ·2 in.). During a deep inspiration the disproportion in the abdominal movement, or rather that at the so-called waist, is still greater, being about ·1 in. when the stays are on, and from ·15 to ·4 in. when they are off. The difference at the waist, when measured with the tape, is very striking, the increased measurement during an extreme inspiration being ·05 to ·3 in. when they are on, and from ·6 to 1·5 in. when they are off. I have found the

circumference at the waist from one to two inches less when the stays were worn than when they were taken off.*

These observations render it certain that the wearing of stays materially influences the respiratory movements, lessening the movement of the diaphragmatic ribs, and exaggerating

* The form of the chest in Ann Winfield, aged 6, (Table I., Case 52,) and Eliza Elsom, aged 11, (Table I., Case 49,) did not materially differ from that in boys of about the same age and size; and in M. Daft, aged 17, (Table I., Case 48,) but whose form and development was that of a girl of 14, the difference in form was inconsiderable.

| | | | |
|---|---|---|---|
| In Winfield, during inspiration, the upper end of the sternum advanced | ·05 in.; | the abdomen | ·25 in. |
| In Elsom, the second rib advanced | ·10 | „ | ·20 |
| In Daft „ „ | ·06 | „ | ·18 to ·20 |

Elsom and Daft both wore stays, and though the stays were loose, yet I conceive that their influence upon the chest had already commenced.

Jane Goodall, aged 33, (Table I., Case 45,) had at one time worn very tight stays; in her, while the lower part of the chest over the intermediate and diaphragmatic ribs was remarkably compressed, the seventh costal cartilages of the opposite sides below the sternum, being pressed near each other, the upper part of the chest was excessively developed. The diameter of the chest from side to side was from fifth rib to fifth rib 10·2 in., and from eighth rib to eighth rib 9·5 in. Compare this with Elsom's chest, in which these measurements were respectively 8·4 and 8·6 in., and with Daft's, in whom the influence of stays was more pronounced, and in whom the measurements were respectively 9·5 in. and 9·3 in.

In Goodall the second rib advanced, during each ordinary inspiration with stays on ·12 to ·2 in., and the abdomen ·08 in., (as well as it could be ascertained,) and the waist expanded during the deepest possible inspiration only $\frac{1}{10}$th of an inch. When she had her stays off, the second rib advanced ·06 to ·08 in., the abdomen ·12 to ·2 in., and the extreme expansion of the waist was about 1 in.

In Eliza Ball, aged 25, (Table I., Case 47,) who had always worn loose stays, the chest was not so excessively full above and contracted below, as was that of Goodall; the upper and lower diameter being respectively 11·7 in. and 11·2 in. The motion of the second rib with stays on was ·05 to ·11 in.; with the stays off ·12 to ·25 in. In Ball, though the stays were loose, they prevented the full expansion of the lower ribs during a deep inspiration; since, when they were on, the extreme expansion of the waist was $\frac{2}{10}$ths of an inch, and when they were off, an inch and a half. Here, although the stays were loose, there was an inch of compression, and the expansion, which ought to have been an inch and a half, was only $\frac{2}{10}$ths of an inch.

In Julia Green, (Table I., Case 45,) the amount of compression from stays was two inches, although the stays were not so tight as usual.

that of the thoracic. Even comparatively loose stays tend to produce this effect; since, though they may allow the ordinary movements of the diaphragm and the lower ribs, yet they do not permit their normal extreme movement, and they prevent the outward displacement of those ribs when the stomach and intestines are distended. I think it probable that in females, even if they wore no stays, the thoracic respiration would be relatively greater, and the diaphragmatic less, than in man; but this is only surmise.

The expansion of the lower ribs is much more impeded by stays than the descent of the diaphragm; indeed, I observed in one instance an increased movement over the lower part of the abdomen when the stays were on, to make up, apparently, for the diminished expansion of the lower ribs.*

### *Respiratory Movements in Children.*

The respiratory movements in children are difficult to observe, owing to their irritability and constant motion.†

Although, in children, the inspiratory movement of the abdomen, indicating diaphragmatic respiration, is greater than that of the upper part of the thorax, yet it is not nearly so much so as it is in the adult: in children, the abdominal

* In Goodall, (Table I., Case 45,) the waist could only expand the tenth of an inch, while the lower part of the abdomen expanded seven-tenths, when her stays were on; yet, when they were off, the waist expanded an inch and a half, the abdomen only half an inch.

† In a child one day old I found the thoracic expansion to be ·03 in., and the abdominal ·03 in.; but the latter was more continuous than the former.

In J. Drake, aged 2 months, (Table I., Case 53,) a perfectly healthy child, observed when asleep, the upper portion of the sternum and the second rib moved forward during inspiration ·02 to ·04 in., while the lower end of the sternum and the sixth cartilage fell back from ·01 to ·02 in., and the lateral motion of the sixth and eighth ribs fell in ·01 in.; the abdominal advance was ·08 to ·15 in., and the diaphragmatic ribs, auxiliary to the diaphragm, moved outwards ·03 to ·04 in.

In Smith, aged 6 months, in perfect health, the upper ends of the sternum advanced during inspiration ·01 to ·03 in., the second rib ·1 to ·15 in., and the abdomen ·1 in.; while the lower end of the sternum and the sixth rib in front and at the sides fell back, during inspiration, from ·01 to ·08 in.

movement being from ·06 to ·15 in., and the thoracic, at the second ribs, from ·02 to ·12 or even ·15 in.

The respiration of children is notably different in this circumstance, that in them the lower end of the sternum and the adjoining cartilages, instead of advancing during inspiration, usually fall backwards. This is especially remarkable during rapid or sobbing inspiration.

The inspiratory falling back of the lower part of the chest is much more marked when the abdomen is large, its amount bearing a ratio to the abdominal prominence.

In children the abdominal organs are of greater bulk than the thoracic; and when, owing to the descent of the diaphragm, the latter replace the former, the walls of the chest collapse wherever the smaller thoracic replace the larger abdominal organs.

If the disproportion between the thoracic and abdominal organs be slight, and the inspiration gradual, the lower part of the chest may possibly not recede.*

When, owing to the inspiration being deep, the lungs enlarge considerably, the lower end of the sternum and the adjoining cartilages advance. When this is the case, they usually recede at the beginning of inspiration, and advance during its progress.†

If the cartilages and ribs be yielding at their junction, as in ricketty children, the sixth, seventh and eighth ribs and their

* In M. A. Scott, (Table I., Case 56,) a well-formed child, comatose, and occasionally breathing freely, who eventually died, and in whom the chest was full and the abdomen moderate in size, the lower as well as the upper end of the sternum, the sixth cartilages, the eighth and tenth ribs, all moved forwards or outwards from ·02 in. to ·05 in., the abdomen advancing ·08 to ·12 in. In this well-formed child, when the breathing was exaggerated, the sixth rib at the side fell in ·01 in. to ·02 in., although during tranquil breathing it moved somewhat outwards.

† In Susan Hotter, aged 2 years 8 months, a healthy child, with a fractured thigh, in whom the abdomen was rather large, the sixth rib, which fell in ·03 in. during tranquil breathing, moved outward ·06 in. when she breathed deeply. In her, when the larger abdominal organs were replaced by the smaller lungs, the ribs over them fell back, but when the lungs were enlarged by deep inspiration, they became larger than the abdominal organs, and then the ribs moved outwards.

cartilages bend inwards at the side, close to their point of junction, during inspiration, and in this case the lower end of the sternum is thrust forward.*

*Summary of the Respiratory Movements in Health.*

In the healthy, robust male, the movement of the sternum and of the thoracic and intermediate ribs, from the first to the seventh, is from ·02 to ·07 in. during an ordinary inspiration, and from ·5 or ·7 in. to 2 in. (the amount varying with the extreme breathing-capacity) during a deep inspiration. The ordinary abdominal movement (diaphragmatic) is from ·25 to ·3 in.; the extreme, ·6 to 1·6 in. The ordinary lateral expansion of the diaphragmatic or lower ribs is greater, and the extreme expansion is usually less, than the respective ordinary and extreme expansion of the thoracic or upper ribs. The expansion of the second ribs is usually alike on both sides; below, all the inspiratory movements, especially those over the heart, are usually somewhat less on the left side than on the right, both during ordinary and extreme inspiration.

In the healthy boy, owing to the greater flexibility of the costal cartilages, the extreme movement of the thoracic ribs is greater in proportion to the breathing-capacity than it is in the adult: the upper portion of the sternum advances more than the lower end during a deep inspiration; but there is little decided difference during tranquil respiration.

In the old man, owing to the consolidation of the cartilages, the motion of the sternum during inspiration is usually greater than that of the ribs (in youth it is less), and the lower end of the sternum usually advances more than the upper.

In females the thoracic expansion is exaggerated, and that of the diaphragm and the lower ribs is restrained, owing, in

* In Mary Wain, (Table I., Case 57,) an emaciated child of 2 years of age, thirsty, having a remarkably large abdomen and a small but prominent chest, the upper portion of the sternum moved forwards ·4 to ·5 in., and the lower portion ·12 to ·2 in., the sixth and eighth ribs and their cartilaginous portions on each side fell in ·02 to ·2 in., at the same time the abdomen moved forward ·15 to ·2 in., and the diaphragmatic ribs outward from ·05 to ·15 in.

great part, to the use of tight stays. The difference is much greater when the stays are on than when they are off.

When the stays are on, the thoracic movement at the second ribs is from ·06 to ·2 in.; the abdominal, from ·06 to ·11 in. When they are off, the thoracic movement is from ·03 to ·1 in.; and the abdominal from ·08 to ·2 in.

The restrained movement of the lower ribs during a deep inspiration is much greater when the stays are on than when they are off.

In infants, the thoracic expansion is considerable, being from ·02 to ·12 in.; while the abdominal is from ·06 to ·15 in. The lower end of the sternum and the adjoining ribs usually recede during inspiration, especially if the abdomen be large and the inspiration quick or sobbing.

### *The Rhythm of Respiration in Health.*

In the perfectly tranquil respiration of the adult, inspiration and expiration are of nearly equal length. The inspiration is slow at the beginning, gradually quickens, and towards the end again becomes slow. The pause between inspiration and expiration is rather a transition than a pause; expiration, like inspiration, begins slowly, soon quickens, and towards the end of the act again becomes slow, gradually passing into the inspiratory act. In many healthy persons, the duration and character of the two acts is exactly the same, each beginning slowly, quickening in the middle, and gradually becoming again slow towards the end. A perfectly normal respiration is, in the adult, exactly pendulum-like in rhythm.

In general, the expiration begins more rapidly and ends more slowly than the inspiration.

In females and children this is almost always the case; in them the inspiration is usually rather quick; the expiration starts off quickly and becomes very slow towards the end. This is especially the case if they be excited or the breathing hurried from any cause whatever. The inspiration is quick and loud. The expiration rushes off at the beginning with an audible gush, and then becomes gradually slower.

| | Duration of Inspiration beats. | | Expiration beats. |
|---|---|---|---|
| In the perfectly tranquil breathing of adults the inspiration is equal to the expiration, or as . . . . . | 6 | to | 6 |
| Frequently in adults the inspiration is to the expiration as . . . . . | 6 | to | 7 |
| In the tranquil breathing of women and children inspiration, is to expiration as . | 6 | to | 8 or 9 |
| In the hurried breathing of females, as . | 6 | to | 10 or 12 |
| In old age the expiration becomes again prolonged, and inspiration is to expiration as | 6 | to | 8 or 9 |

When the expiration is prolonged, it usually begins quickly and ends slowly; and it may be observed that, in this case, the diaphragm ceases to act before the end of the expiration, while the costal contraction continues, however slightly, to the end of the act.

In many healthy persons having prolonged expiration, the expiratory action of the diaphragm begins, perceptibly, before that of the ribs.

## PART II.—CAUSES THAT DISTURB THE RESPIRATORY MOVEMENTS, THE LUNGS THEMSELVES BEING HEALTHY.

### SECT. I.—*Cases in which the Motion of the Ribs of both Sides is restrained.*

In posterior curvature at the fifth and sixth dorsal vertebræ the motion of all the ribs above the curvature, and of the upper portion of the sternum, is restrained though not annihilated, while that of the ribs below it, and of the lower end of the sternum, is exaggerated; the action of the diaphragm being much increased.

If the curvature be at the last dorsal vertebra, the motion of the ribs immediately above is restrained, while that of the thoracic ribs and the abdomen (diaphragm) is exaggerated.*

* Effect of posterior curvature of the spine on the respiratory movements:—

In the two cases observed with the chest-measurer, the motion of the

## SECT. II.—*Cases in which the Motions of the Ribs on one Side may be restrained.*

These are, lateral curvature of the spine; injury or disease of the ribs; of the intercostal muscles, including pleurodynia; of the mamma; or of the axilla, shoulder, or arm, and probably hemiplegia.*

A.—*Effect of lateral curvature of the spine on the respiratory movements.*—In excessive curvature with the convexity to the right, the left lung is very small, and the left ribs

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ribs superior to the curvature was much interfered with. In the boy Bulwer, (Table II., Case 58,) in whom the first five dorsal vertebræ were perfectly horizontal, and all below the sixth quite vertical, the motion of the second rib was ·05 in., and of the fourth costal cartilage ·02 in., while that of the right eighth rib was ·1 in., and the left ·12 in., and that of the right diaphragmatic rib was ·18, and the left ·07. The motion of the sixth rib, which was immediately below the curvature, and the usual motion of which is less than that of the second, was, in Bulwer, even greater than that of the second. The lower end of the sternum, which was considerably more prominent than the upper, moved forward ·15 in., while the upper part of the long bone moved forward only ·05 in. This great increase in the motion of the lower end of the sternum is due to the greatly increased range of motion of the lower ribs. The motion of the abdomen, which was greatly increased at the sides, was but little affected in front, the movement at each side being ·18 in., while that in the centre was only ·2 in. In the case of a youth, (Table II., Case 59,) obligingly shown to me by Mr. Hare, whose posterior curvature had been (as shown on a cast) very great indeed, but was then very materially lessened, the motion of the lower end of the sternum, which protruded considerably, was ·1 in., while that of the upper end of its long bone was only ·02 in. The abdominal motion was, in this case, very great anteriorly, being, in tranquil respiration ·5 in., and on deep inspiration 1·5 in.; but the lateral abdominal movement was only ·1 in. on the right side, and ·07 in. on the left.

* Effects of hemiplegia on the respiratory movements:—

I have made a cursory examination of several cases of hemiplegia, but have not met with one in which the amount of respiratory movement was palpably affected.

Dr. Todd favoured me with the examination of the case of Williams, (Table, Case 72,) at King's College Hospital, who had, in addition to hemiplegia, mitral regurgitation. In this poor woman the left second rib moved ·08 in., while the right moved ·06 in., consequently this rib was not affected by the paralysis; over the fourth and sixth ribs, and, to a less degree, over the diaphragmatic ribs, the motion was lessened, and, at

are all approximated, while the right ribs are unusually far apart. During inspiration, the whole costal and diaphragmatic expansion of the left side of the chest is restrained, while that of the right side, especially of the diaphragm and diaphragmatic ribs, is exaggerated.

If the convexity be to the left, the motion of the right side is restrained and that of the left exaggerated.*

If the curvature be inconsiderable, the costal motion may not be modified, though that of the diaphragm may, that

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the sixth rib, was reversed on the left side; but this was manifestly due, not to the paralysis, but to the heart disease.

In the child, E. Brooks, (Table II., Case 73,) who suffered from left hemiplegia, there was little or no marked difference between the motion of the two sides.

Although I have not yet met with a case of paralysis in which the respiratory movements were affected, I think it likely that such cases exist. Paralysis of the voluntary muscles is complete in chloroformization, and yet the respiratory movements remain if the inhalation be not pushed too far. It is therefore clear that even in complete hemiplegia of the voluntary muscles, there may be no hemiplegia of the respiratory muscles. Under chloroform the diaphragm continues in action after the costal respiration has ceased. I think it probable that the same state of things may obtain in some cases of hemiplegia; that there may be hemiplegia of the costal muscles while the diaphragm on the affected side remains active.

* Movements of respiration in excessive lateral curvature:—

The ribs articulating with the concavity of the curvature are approximated, as is well shown in the figure in Mr. Bishop's papers on deformities, in the Lancet, p. 63, July 1846 (while those articulating with the convexity of the curve are separated). In a girl, Jane Clifton, having extreme lateral curvature to the left side, of whom I have a diagram, the lower end of the sternum was drawn over, as well as the curvature, considerably to the left; the right lung was greatly diminished in size (it weighed 7 oz., while the left lung weighed 15 oz.), and the right belly of the diaphragm was much lessened.

In the case of a young person (Table II., Case 61) having extensive curvature to the right, (with the examination of whom Mr. Hare favoured me, and in whom the curvature, when I saw her, had been much lessened,) the motion of the right second rib was ·2 in.; left, ·1 in.: right fourth rib, ·15 in.; left, ·03 in.: sixth rib, right, ·15; left, ·08: tenth rib, right, ·15 in.; left, ·03 in.: and in the abdomen, that of the right side was ·15 in., and left ·03 in. The central motion of the abdomen was ·35; of the lower end of the sternum, ·12, and the upper end, ·15.

side of it having the greatest motion which is in the direction of the convexity.*

B.—*Effects of injuries or diseases of the ribs or parts contiguous to the ribs on the respiratory movements.*—Non-motion or diminished motion of one side of the chest may exist, and yet the lungs may be perfectly healthy. The cases given below† prove that the respiratory motion of the

* In the case of Beaton (Table II., Case 62) the lateral curvature with the convexity to the right side was slight, affecting the lower dorsal vertebræ. The gastric bulge was almost obliterated, while the hepatic bulge was greatly increased. In him the motions of the left side were generally nearly equal to those on the right side, or that of the spinal convexity. The difference in the motion in this boy's left diaphragmatic ribs was more markedly lessened, being ·03 in tranquil, and ·15 in deep respiration, while on the right side these ribs had the respective motions of ·06 and ·35.

† Respiratory movements modified by injury to, or disease of, the parts contiguous to the ribs, the lungs being healthy :—

I have a diagram, taken from a boy who, some years since, had his left arm almost dragged off by machinery; the arm was removed at the shoulder-joint; the chest was itself uninjured; the lungs perfectly healthy. The whole of the left side had shrunk in, and, so far as the eye could judge, was motionless, while the right side was capacious and moved freely. The lower margin of the right lung descended during a deep inspiration nearly an inch, while the descent of the left lung was not perceptible, and the heart descended five-eighths of an inch. In this boy, as the wound healed, the size and motion of the left side gradually increased, until at length it was equal to, or probably even greater than, that of the right side. Here, there was no injury to the ribs, and no affection of the lungs, yet the ribs adjoining the injury did not move.

In the case of a woman, aged about 40, admitted into the hospital, there was deep-seated cellular inflammation around the left scapula and shoulder-joint. She had a cough, expectorated frothy mucus, and had diminished motion, with falling in, and partial dulness on percussion over the second and third ribs below the left clavicle. The question presented itself, did this dulness on percussion and non-motion depend upon disease in that part of the lung, or on the extensive and painful disease in the contiguous structures? There were varying mucous and sonorous rhonchi in different parts of the chest, not more so at one part than another, and the presumption that the external disease was the cause of the non-motion was confirmed by the autopsy, which revealed extensive suppurative inflammation around the scapula, and general bronchitis; but there was no perceptible disease in the upper part of the left lung.

In Severn, (Table II., Case 63,) a lad in whom the left shoulder and left side of the neck and head were severely injured in a coalpit, but in whom

whole of one side of the chest, or of any of the ribs, may be restrained, prevented or reversed; by the fracture of a

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there was no perceptible injury to the lungs or even to the ribs, the left second and third ribs fell in ·06 in. during inspiration, while the right second rib moved forward ·03 to ·06 in.; the movements of the left diaphragmatic ribs and the left side of the abdomen were but little less than those of the right side. His recovery was slow. Several months after the injury, being then well, he was again examined, and it was found that the movement of both second ribs was alike. The exact injury was never ascertained in this case; but, from the complete recovery of lost motion, it is almost certain that his ribs were uninjured.

In the case of Frost, (Table II., Case 64,) extensive deep-seated cellular inflammation of the left arm; in that of Bingham, (Table II., Case 65,) fracture of the left arm; in that of Lane, (Table II., Case 66,) erysipelatous abscesses in the right axilla; and in that of Mrs. Barker, (Table II., Case 67,) an extensive scirrhous ulceration of the mamma,—caused in each instance restraint in the motion of the contiguous thoracic ribs to an extent varying in proportion to the severity of the injury or disease. In the case of Ward, (Table II., Case 68,) there was an irregularity in the second rib from the union of a fracture inflicted years before: during tranquil breathing, though not during a deep inspiration, the motion of that rib was less than that of the corresponding rib on the left side. In the case of Parker, (Table II., Case 69,) there was an abscess between the second and third costal cartilages, and there were good reasons for thinking that no disease existed in the lung itself. The various motions of the second, fourth and sixth ribs were materially less on the affected than on the sound side, while those of the diaphragmatic ribs were quite normal. Sketchley, (Table II., Case 70,) a stout fellow, a porter, suffering habitually from bronchitis, was brought lately into the hospital with emphysema diffused through the cellular tissue of the body and right arm and hand; the third left rib was broken, causing a loud jerk during each inspiration. There was no pneumothorax; noisy rhonchi were audible over the whole chest. In this man the ribs of the injured side fell in during inspiration, while those of the right side in part moved forward. This case is, of course, complicated both with disease of, and injury to, the lung; but the side on which the injury was seated could be fixed upon, without the aid of any other sign, by the reversed motion of the affected side. The injured side in this case was indeed discovered by this sign before the precise injury was made out.

In addition to the causes just illustrated, pleurodynia may restrain the local respiratory movement, as the case of John Moore (Table II., Case 71,) evidences. He complained of a violent intolerable pain between the fourth and fifth left costal cartilages on moving or taking a deep breath, or rising in bed, or making any quick motion; indeed, his involuntary cries were

rib, abscesses in the intercostal spaces, local pleurodynia, inflammation of the axilla, shoulder-joint, or arm, or fracture of the arm,—in short by any injury or affection of the ribs or of the parts contiguous to the ribs. Whenever, indeed, the motion of one or more ribs would give pain to or injure either the ribs, the intercostal muscles, or any neighbouring part, their respiratory movements may be restrained or arrested.

### Sect. III.—*Cases in which the Motion of the Ribs on one Side may be permanently exaggerated.*

This happens from the loss of an arm, and certain congenital or acquired malformations.

When an arm is cut off, the weight with which it formerly bore upon the thoracic ribs is necessarily removed, the ribs are less restrained in motion on the mutilated than on the sound side, and the movements of those ribs are consequently exaggerated.*

In some persons there is excessive development of the right third, fourth and fifth costal cartilages; the respiratory movements may then be abnormally great over the unusually developed costal cartilages.

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very loud and agonising, and were accompanied by universal violent contraction of all the expiratory muscles.

The respiratory movements during tranquil breathing were everywhere normal, except at the region of the pain, over the left fourth and fifth costal cartilages, the motion on the right side was ·04 in., and that on the affected side ·005 in., sometimes ·03 in.

In this man there were no signs either of lung or heart disease, and the pain was evidently exclusively muscular. The normal character of all the other movements, except at this isolated patch, was in itself a demonstration of the soundness of the thoracic organs.

* Effects of the permanent loss of an arm on the respiratory movements :—

The removal of an arm necessarily lightens the weight with which it bore upon the ribs. The thoracic ribs are less compressed on that than on the opposite side. In W. Glossop, (Table II., Case 75,) a boy whose left arm was removed below the deltoid some weeks before, for an injury, the motion of the right second rib was ·15 in. to ·4 in., while that of the left was ·1 in. to ·3 in. The whole of the rest of the movements were quite normal. I do not doubt that this isolated case is a perfect type of its class; it is so reasonable that the ribs should move more freely after the removal of the greater part of what was before a compressing weight.

SECT. IV.—*Cases in which the Motion of the Diaphragm, both during tranquil and deep Inspiration, is restrained.*

The motion of the diaphragm is restrained throughout by peritonitis, abdominal tumours, especially those connected with the diaphragm, and aortic aneurism. It is restrained on the right side only by greatly enlarged liver, from abscesses or hydatid cysts, and adherent liver.

A. — *Effect of peritonitis on the respiratory movements.* —In peritonitis there is always great intestinal distention. The diaphragm is raised, and the lungs and heart are in consequence compressed upwards. The descent of the diaphragm and the abdominal movements are very much restrained, especially at the centre, where they are, indeed, sometimes annihilated. The diaphragmatic or lower ribs partake of the diminished movement of the diaphragm, to the action of which they are auxiliary. The motion of the superior or thoracic ribs is very much augmented. The movement of the lower end of the sternum is scarcely altered, its tendency to diminished motion, owing to the restrained diaphragmatic movement, being a little more than balanced by the exaggerated forward movement of the thoracic ribs.

The motion of the abdomen at the side is not so much lessened as it is in front, especially, I conceive, if the peritonitis do not seriously affect the serous surfaces of the diaphragm, and the liver, spleen and stomach.*

* Effect of peritonitis on the respiratory movements :—

The diaphragm in peritonitis is nearly at rest, as during each inspiration the diaphragmatic movement would necessarily rub the inflamed surfaces upon each other, and thereby increase the affection. We consequently find that in peritonitis the diaphragmatic motion is very much restrained.

In the case of Barratt, (Table II., Case 76,) a man in the hale and prime of life, affected with extensive peritonitis following the operation for hernia, the central abdominal expansion in tranquil breathing, which ought to have been ·3 in., was ·01 to ·05 in., and the costal breathing at the second rib, which ought to have been ·02 in. to ·04 in., was ·16 in. to ·22 in. In the same way, in Kew, (Table, Case 77,) a young man with retention of urine and universal peritonitis, the abdominal movement was ·06 in.,

In *diffused* peritonitis, the restrained abdominal movement is central and diffused; when the inflammation is

and that of the left second rib was ·3 in.; and in Hussey, (Table II., Case 78,) a female with peritonitis, the abdominal movement was ·03 in. and that of the left second rib ·4 in. In all these cases the central abdominal movement was slight, while the thoracic respiration was much exaggerated. The diminution of the abdominal and exaggeration of the thoracic breathing being in an inverse ratio to each other, as the one falls the other rises, until the actual amount of each may be exactly translated, the abdominal movement falling from ·20 in. or ·30 in. to ·03 in. or ·06 in., and the thoracic movement rising from ·03 in. or ·06 in. to ·20 in. or ·30 in.

In the case of Severn, (Table II., Case 79,) a spare young man who had chronic peritonitis with abdominal effusion, and from whom the effusion had almost but not entirely disappeared, the diminution of the central abdominal movement was proportioned to the mildness of the disease, it being ·08 in. to ·13 in., while that of the second ribs was ·1 in., and of the upper sternum ·13 in.; the proportion of diminished abdominal and increased thoracic movements being here, as in the extreme cases, strictly kept.

We may refer to Simpson's case, (Table II., Case 81,) in which the same ratio obtained, owing to an abdominal tumour, without peritonitis, the abdominal advance being here ·15 in. and the thoracic ·10 in. or ·08 in.; and to the case of Clarke, (Table II., Case 84,) with abdominal distention, in whom the abdominal advance was ·20 in. and the thoracic ·08 in. or ·09 in.; and to that of Barton, in whom, from hepatic or abdominal adhesions, the abdominal movement at the centre was ·10 in., preceded by falling in, and the costal advance was on the left side ·30 and on the right ·19 in., the left movement being further exaggerated in his case by the restrained movement of the whole right lung.

Indeed, this important law of compensation obtains in every disorder of respiration,—when the movement is restrained in one part it makes up for it, and often more than makes up for it, in another. Besides this, in peritonitis, the demands on respiration, owing to the severity of the disease, are increased, and the respirations are not only more frequent but deeper.

It will be observed that in all the cases of peritonitis given, three of which were fatal, the lateral abdominal movement was but little lessened, being—

| | At the sides of the abdomen— Right. | Left. | While at the centre it was— |
|---|---|---|---|
| In Barratt . . . . . | ·02 in. | ·0 in. | From ·01 in. to ·06 in. |
| In Kew . . . . . | ·07 | ·08 | ·06 |
| In Hussey . . . . . | ·07 | ·06 | ·03 |
| In Severn . . . . . | ·1 | ·1 | ·08 ,, ·13 |
| In healthy males . . | ·09 | ·09 | ·25 ,, ·3 |
| In healthy females . | — | — | ·1 ,, ·2 |

[The figures denote the forward movement during inspiration.]

The case of Barratt, the only exception, is the best proof of the completeness of the law, that, when peritonitis is local, the motion of the con-

*local*, the motion of the contiguous abdominal walls is lessened.

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tiguous abdominal walls is lessened. The peritonitis in this case followed the operation for strangulated femoral hernia on the *left* side, and there was no lateral motion whatever on the left side, while on the right it was ·02 in.

While the motion of the thoracic ribs was exaggerated, that of the diaphragmatic ribs was diminished. This is in accordance with the whole auxiliary function of those ribs.

The sixth rib has a slightly increased motion. Being the superior of the intermediate set, it partakes more of the increased motion of the thoracic than of the diminished motion of the diaphragmatic ribs.

In the subjoined Table, the abdominal movement may be compared with that of the diaphragmatic ribs, and contrasted with that of the second ribs, and both may be compared with that of the sixth costal cartilages.

| | Abdominal movement. | | | Diaphragmatic ribs. | | Second ribs. | | Sixth costal cartilage. | |
|---|---|---|---|---|---|---|---|---|---|
| | right. | centre. | left. | right. | left. | right. | left. | right. | left. |
| 1. Barratt . . . | inch. ·02 | inch. ·01 to ·06 | inch. ·00 | inch. ·06 | inch. ·06 | inch. ·16 to ·22 | inch. ·16 to ·22 | inch. ·08 | inch. ·06 |
| 2. Kew . . . . . | ·07 | ·06 | ·08 | ·05 | ·03 | ·20 | ·30 | ·06 | ·06 |
| 3. Hussey . . . | ·07 | ·03 | ·06 | ·02 | ·02 | ·33 | ·40 | ·07 | ·08 |
| 4. Severn . . . | ·10 | ·08 to ·13 | ·10 | ·05 | ·05 | ·10 | ·10 | ... | ·05 |
| 5. Average male | ·09 | ·25 to ·30 | ·09 | ·10 | ·10 | ·03 to ·07 | ·03 to ·07 | ·03 to ·06 | ·02 to ·05 |
| 6. Average female | ... | ·10 to ·20 | ... | ... | ... | ·05 to ·10 | ·05 to ·10 | ·03 to ·05 | ·02 to ·05 |

[The figures denote the forward movement during inspiration.]

We see that the sixth intermediate cartilage has an intermediate amount of motion; and we also find that the advance of the lower end of the sternum bears a close ratio to that of the sixth costal cartilage. Consequently, while the motion of the upper portion of the long bone of the sternum is greatly exaggerated, that of the lower end is about the same as in the healthy state, as is well illustrated by the actual movements in the above cases.

| | Upper end of sternum. | Lower end of sternum. | Sixth costal cartilage. | |
|---|---|---|---|---|
| | | | right. | left. |
| Barratt..... | inch. ·10 | inch. ·05 | inch. ·08 | inch. ·06 |
| Kew ..... | ·15 | ·04 | ·06 | ·06 |
| Hussey..... | ·20 | ·05 | ·07 | ·08 |
| Severn ..... | ·13 | ·05 | .. | ·05 |
| Average healthy male .. | ·03 to ·06 | ·02 to ·06 | ·03 to ·06 | ·02 to ·05 |
| Average healthy female | ·06 to ·10 | ·03 to ·06 | .. | ... |

[The figures indicate the forward movement during inspiration.]

Owing to the great exaggeration of thoracic respiration, the head, in peritonitis, is visibly lowered during each inspiration.*

*Rhythm of respiration in peritonitis.*—In one case only, that of Barratt, was the rhythm noted, and in him inspiration was longer than expiration. The abdominal expiratory muscles are, in peritonitis, always tense; they offer, in consequence, resistance to the diaphragmatic movement, and they support the inflamed surfaces. Even during inspiration, the expiratory muscles act, resisting and retarding the inspiratory act; while, during expiration, the momentum is, as it were, already in action, and the expiration is shortened.

Shortened expiration may be regarded as one of the effects and signs of peritonitis.

B.—*Effect of abdominal tumours and aortic aneurism when contiguous to the diaphragm on the movements of respiration.*—Abdominal tumours will have a greater restraining effect on the movements of respiration the higher they are, and the more closely they are attached to the diaphragm. In Simpson, (Table II., Case 81,) a hard tumour, the size of a cricket-ball, was seated in the abdomen, between the sternum and the umbilicus; it was raised at each aortic pulsation, though it had no lateral pulsation of its own. During inspiration, the abdomen advanced ·15 in., being only half the normal movement. The motion of the diaphragmatic ribs was unusually small, being only ·05; while that of the thoracic ribs was above the average, being from ·05 to ·1 in.

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* Local peritonitis:—

Ch. Osborne had, when suffering from fever, lasting pain over the head of the colon. There were, unquestionably, ulcerations in the mucous follicles, in the first instance; and, afterwards, partial peritonitis. This is inferred from the fact of the partially restrained motion over the seat of the head of the colon. In cases of fever attended by ulceration of the inflamed mucous membranes, there is usually no restraint of abdominal motion. In Osborne's case, contrast the motion over the head of the colon, ·06 in. to ·08 in. with that over the corresponding region of the opposite side, which is ·15 in., and, at the centre, from ·10 in. to ·15. in. Here the motion was restrained fully one half.

In a case of abdominal aneurism (with the observation of which I was favoured by Dr. Burrows) pointing to the side of the left seventh costal cartilage, the contiguous abdominal movements were less than those of the corresponding parts on the right side.

C.—*Effects of greatly enlarged liver on the respiratory movements.*—If the liver be simply enlarged, it finds its way downwards and to the left, and therefore does not encroach much on, or embarrass the movements of, the diaphragm, especially in the erect posture.

If there be large adventitious deposits in the liver, as hydatid cysts, malignant tumours or abscesses, the form of the organ is changed; it then often protrudes upwards, displacing the diaphragm upwards and restraining its descent.

In such cases the descent of the right side of the diaphragm and the movements of the diaphragmatic and intermediate sets of ribs are very much restrained. The motion of the thoracic ribs of the right side, though often somewhat exaggerated, is usually much less so than that of the left thoracic ribs. The movements of the left thoracic and intermediate sets of ribs are much exaggerated. The motion of the upper end of the sternum is much greater than that of the lower end. The abdominal movement at the centre and on the left side is not materially affected.*

* I possess a diagram, taken from a young man in whose liver were several large abscesses. He had also peritonitis, and great intestinal distention. In this case, the hepatic bulge is enormous. The heart is displaced upwards, and altogether to the left of the centre of the sternum, and the upper convexity of the liver rises as high as the second intercostal space (Table II., Case 82).

In the case of a young person whose habits had been athletic, but who was, when examined, much attenuated, the hepatic bulge was very large. The liver was of great size, encroaching, upwards, on the right lung; forwards, on the costal cartilages; and, downwards, many inches below its usual site. Two rounded swellings, one of great size, evidently with fluid or semi-fluid contents, (hydatids ?) in the substance of the liver, could be felt below the costal cartilages. The right lung was much duller on percussion than the left. Its lower lobe was evidently consolidated, while the upper was resonant and respiring. The heart was

If the liver be adherent, especially if the base of the right lung be adherent also, I infer from the cases referred to below* that the action of the right side of the diaphragm is much restrained, but more so in front than behind.

The extreme inspiratory movements and the breathing-capacity are much diminished in persons suffering from greatly enlarged liver, containing adventitious deposits, and also, I conceive, in those in whom the liver is adherent.

SECT. V.—*Cases in which the action of the Diaphragm is slightly lessened during an Ordinary Inspiration; considerably restrained during a Deep Inspiration.*

These are cases of *general abdominal distention* from flatus, ascites, or extensively enlarged and adherent ovarian cysts.

In the extreme cases, the motion of the diaphragm also is restrained during an ordinary inspiration.

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somewhat displaced to the left, evidently by the enlarged liver. The left lung was everywhere resonant, and expanded freely. In this case, the enlargement of the liver was complicated with consolidation of the lower lobe of the right lung. The effect of each morbid state on the respiratory movements was traceable. The whole of the respiratory movements of the right side were restrained or reversed, while the whole of those of the left side were exaggerated. The motion of the right diaphragmatic ribs, over the liver, was particularly affected, as they fell in ·02 in. to ·03 in., while those of the left side moved outwards ·05 in. The falling in, or non-motion, of these ribs may be considered the special effect of the enlarged liver. The motion of the fourth and sixth costal cartilages was 0 in. and ·01 in. on the right side, and ·04 in. on the left side. Here the influence of the consolidated right lower lobe combined with that of the enlarged liver to restrain the movements. The expansion of both upper lobes was exaggerated; but, while the right second rib advanced ·10 in., the left advanced ·25 in., the motion of the right being restrained by the condensed lower lobe and the enlarged liver. The upper end of the sternum, in conformity with the abnormal influences, advanced more than the lower end, in the proportion of ·10 in. to ·04 in. The abdominal motion was not much lessened, being, at the centre, ·25 in.

* I believe that in Barton, (Table II., Case 83,) aged 32, and Stone, (Table II., Case 84,) aged 69, the liver was adherent to the diaphragm. In them, the lower margins of the right lung and liver did not descend perceptibly during a deep inspiration, while the lower margin of the left lung descended freely.

Abdominal distention elevates the diaphragm, presses upwards the lungs and heart, and lessens their size.

The motion of the thoracic ribs is somewhat exaggerated during ordinary breathing; that of the diaphragm, except in extreme cases, being scarcely altered.

During a deep inspiration the increased motion of the diaphragm is unusually small, while that of the thoracic ribs is considerable.

If the stomach be greatly distended, the expansion of the left side of the chest is less than that of the right.*

* Effects of abdominal distention on the respiratory movements:—

In the case of Clarke, a lad who died from diabetes, caused and kept up by masturbation, the abdomen was much distended by *flatus*; the abdominal muscles were permanently rigid; the chest was flat, while the gastric bulge, and, to a less extent, the hepatic bulge were unusually prominent; the lower costal cartilages and ribs being pushed outwards, both to the sides and in front. The thoracic viscera were pushed up by the abdominal distention; the lower boundary of the lungs and heart was high, being behind the fourth intercostal space, instead of the fifth. The motion of the left side of the chest was throughout less than that of the right, the chief abnormal difference being at the seat of the chief distention, which, as is well shown in the diagram now before me, was due to the enormously swollen stomach and colon. These encroached upwards on the left lung and the heart more than the liver encroached on the right lung; the movement of the right fourth and sixth cartilages and the sixth rib were respectively ·08, ·10 and ·09 in., while those of the left were ·05, ·05 and ·05 in.; the right and left second ribs had the same motion, ·08 in., in tranquil breathing, but on deep inspiration the difference was marked, being over the right 1·10 in. and over the left 1 in. The abdominal motion was somewhat lessened in tranquil breathing, being at the centre ·20 in.; but during a deep inspiration the increase was unusually small, being only ·50 in. In Clarke, the left lung was perfectly sound, as the autopsy manifested; and yet the anterior expansion of the left lung was considerably less than that of the right. This was due to the upward pressure of the stomach being more immediate than that of the liver, and to the comparative non-descent of the heart, which, therefore, could not be replaced by the anterior superior portion of the lung. In health the heart descends, as already stated, to a great extent, and makes way for the expanding lung.

The upper boundary of the liver, the highest part of its convexity, lay behind the third intercostal space, the liver being pushed upwards by the distended stomach and bowels.

The very small size to which the lungs are reduced by abdominal dis-

## Sect VI.—*Cases in which the Respiratory Movements are unaltered during both Tranquil and Deep Inspiration.*

Such are cases where there are ovarian cysts of moderate size free from adhesions; and the impregnated state, even to the last months.

*Enlarged ovarian cysts*, when they are free from adhesions, and of moderate size, do not modify the respiratory movements. When they are very large, they restrain the extreme diaphragmatic movement; and when they are adherent, they restrain that movement still more. The cysts descend freely, to the extent usually of an inch, when they are free from adhesions; but only to a slight extent when they are adherent: a test is thus afforded of the presence or absence of adhesions by the non-descent or the descent of the cyst during inspiration. Dr. Frederick Bird habitually avails himself of this test.*

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tention fully explains the distress occasionally seen in peritonitis and other affections.

I have not observed any case of *ascites* with the chest-measurer; but the general effect is undoubtedly the same with that from accumulated flatus. A greater amount of distention can usually be borne from ascites than from accumulated flatus, as the accumulation in the former is slow, and the system adapts itself to it, while in the latter it is usually quick; for the same reason the diaphragm can be forced higher in extreme cases of ascites than in distention from flatus.

In Frederick Green, the subject of ascites, a diagram of whom is given at p. 398 of my paper in the Provincial Medical Transactions, the diameter of the left side is an inch less than the right. The cartilages of all the lower ribs are thrust outwards.

* Abdominal distention from ovarian dropsy:—

This state differs from ascites in that the tumour does not affect the diaphragm in the earlier stages; and at the later stages only acts intermediately on it, pushing it upwards. From the enormous size sometimes attained by the ovarian cysts, they may elevate the diaphragm to the utmost extent. In one diagram in my possession, from a case of ovarian dropsy, in which the cysts were enormous, the upper convex boundary of the liver was just below the second rib. I have not observed any cases of this class with the chest-measurer; but I possess three diagrams taken from living cases.

In the case in which the ovarian cysts were very large, the descent of the diaphragm, though much restrained, was quite appreciable, and in the

In the pregnant state, the respiration, whether tranquil or deep, is not interfered with; indeed, I conceive that, in the present mode of dressing, the breathing is carried on with less interruption in the impregnated, than in the unimpregnated, state, owing to the requisite loosening of the stays. At the same time, the increased demands on the vascular system in the pregnant state call then for increased respiratory movements.*

If the abdominal distention be very great in the impregnated state, I doubt not but that the diaphragmatic movements will be somewhat restrained.

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other two cases the descent was considerable, being in one scarcely diminished. In both these cases, the inspiratory descent of the upper boundary of the tumour was at least an inch, manifesting that there were no adhesions. Dr. Frederick Bird informs me that he judges that the ovarian cyst is free from adhesion if its inspiratory descent be considerable.

* Influence of parturition on inspiratory movements:—

This is not of course a pathological influence; but it is so closely analogous in its effect to some of the causes (ovarian dropsy) of abdominal distention, that its effect can be most readily studied in this place.

I have before me two diagrams from women, one being in the sixth the other in the ninth month of pregnancy. In both of these the diaphragmatic descent, ascertained by percussion, was very little affected; the lower border of the lungs and the liver descended on each side about an inch, and the upper boundary of the gravid uterus descended at each inspiration a full inch; indeed, the impregnated uterus has a natural inclination to fall forwards out of the way of the abdominal viscera, thus making room for them during the displacement.

I observed two pregnant women (Table II., Cases 86, 87) with the chest-measurer. In both of them the costal movements were perfectly normal, being unexaggerated; the motion of the second rib being in each only ·05 in., half the usual amount in women wearing stays. This tranquil state is, no doubt, due, in great part, to the impossibility of these persons wearing tight stays. In Sands, the abdominal expansion at the centre was only ·10 in., somewhat less than that in health with the *stays off*; but the expansion over the whole abdomen was equal, there being a motion on the right and left side of ·10 and ·08 in. As the whole abdomen was increased in size, the diaphragmatic descent diffused its effect over a more extended surface than in the unimpregnated state; consequently we may infer that in these persons the diaphragmatic descent was fully equal to that in the unimpregnated. In Mrs. Key, whose abdomen was very much distended, the descent was not so great, being ·08 in. at the centre, and ·04 ·06, or ·08 at the side.

### SECT. VII.—*Effects of Disease external to the Thorax on the Rhythm of Respiration.*

The rhythm of respiration is not materially altered by any of the causes that affect the respiratory movements, when the thoracic organs are healthy, except peritonitis, in which the expiration is shorter than the inspiration.

The want of alteration in the rhythm of respiration in these cases is one of the means by which they may be distinguished from diseases of the chest.

## PART III.—ON THE EFFECT OF DISEASES OF THE RESPIRATORY ORGANS ON THE MOVEMENTS OF RESPIRATION.

Having inquired into the movements of respiration in health, and into the abnormal causes which modify those movements, the heart and lungs remaining healthy, we now inquire into the modifications of the respiratory movements, caused by diseases of the respiratory organs.

### SECT. I.—*The Effect of Obstruction to Respiration in the outer Breathing Passages on the Movements of Respiration.*

The obstruction to respiration may exist in the nostrils and palate, the fauces, the larynx, or the trachea.

If the obstruction to respiration be considerable, the diaphragm is low, the lower boundaries of the lungs and heart are drawn down, and the chest is elongated, narrowed, and flattened. Owing to the falling back of the lungs to each side of the heart, a large portion of that organ is in contact with the walls of the chest, and its impulse is felt over a considerable space.

The efforts to inspire are powerful, but more or less inefficacious and struggling, in proportion to the amount of the obstruction. Inspiration and expiration are performed with a loud, harsh, hissing noise—often audible over the whole room.

The respiratory muscular efforts are powerful, but the motions are restrained.

The diaphragm, which is permanently low, descends during inspiration with great force; but the abdominal movement is seldom greater, and is often considerably less, than it is in ordinary healthy inspiration.

*The walls of the chest recede during inspiration.*—The motion of the chest is very peculiar. Instead of the ribs and sternum obeying the inspiratory muscular efforts, in extreme cases, where the obstruction to respiration is almost complete, the sternum and the costal walls fall backwards, the whole chest collapsing during each inspiration. At the same time, the abdomen protrudes, owing to the descent of the diaphragm; and the lower or diaphragmatic ribs, instead of falling in like the rest of the ribs, move outwards to a slightly exaggerated extent. The outward motion of those ribs is owing to their action being purely auxiliary to that of the diaphragm. It is only in extreme cases that the whole thoracic walls fall in: usually, the upper thoracic ribs (the second) advance, while the lower end of the sternum and the adjoining cartilages and ribs recede. It is manifest that the costal muscles are powerfully exerted, but their force is overpowered by a stronger force, and, yielding in the struggle, the lower end, and sometimes perhaps the whole, of the sternum and the thoracic walls fall backwards, instead of advancing, during inspiration.

See the cases detailed below, illustrating this interesting subject.*

* Effect of narrowing of the outer breathing passages on the movements of respiration:—

I have before me two diagrams, taken from William Piner, one immediately before, the other some time after, the operation for laryngotomy was performed. I extract the following from the report of his case:—"May 18, 1843.—W. Piner, aged 34.—He breathes with difficulty, and with a loud noise, on expiration; is very pale; his countenance expresses distress, anxiety and starvation. A very small quantity of air enters at each inspiration, to effect which the abdomen is much protruded, but the sternum falls backward about half an inch at the lower end, and one-eighth of an inch at the upper. This is due to the diaphragm, at its descent, dragging down the base of the lung; and as air cannot rush in

The cause of the collapse of the chest during inspiration is very apparent, and is well illustrated by an observation made

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through the narrowed larynx to fill up the chest, the pressure of the external air forces in its walls: the pulse is just perceptible, 130. The soft palate and the pillars of the fauces are matted together, hard, cartilaginous, contracted, united apparently to the vertebræ, and forming one large contracted cicatrix.

"2½ P. M.—Mr. White forced a curved trochar and canula into the larynx, between the cricoid and thyroid cartilages; the patient immediately inspired freely through the canula. The chest expands freely; the sternum no longer falls back, but rather moves forward; pulse much stronger; face red, and surface warm; heart's action perceptible; expression of anxiety gone. He soon fell asleep, when the respirations, previously 20, were 12 to 16 per minute."

In this man, *before* laryngotomy, the chest was flattened and narrowed, especially on the left side, the size of the right side of the chest being larger, owing to the presence of the liver. The lower margin of the right lung was behind the seventh cartilage, a full inch below its normal site. *After* laryngotomy, the lower margin of the right lung ascended a full inch. The chest became normally full and well developed; the chief increase being on the left side. The action of the diaphragm was no longer violent; when he took a deep inspiration it descended three-quarters of an inch.

In another case of laryngitis, (the case of Daniel Bull,) in which Mr. White performed laryngotomy, and on which observations were made with the chest-measurer, the whole sternum, and sometimes the whole thoracic walls, fell in during each inspiration. Immediately after the operation the normal inspiratory expansion returned.

At whatever part of the air-passages the obstruction may be, the general effect will be the same.

There will be the same difficulty to the entrance and exit of air through the air-passages, whether the obstruction be in the nostrils and palate, as in Robinson, from erysipelas; or in the fauces, from enlarged tonsils, as in Chester, ill with scarlatina (Table III., Case 88); or in the larynx, from inflammation, as in Scattergood; or from laceration of the trachea, as in Slater; or in the trachea, from bronchocele, as in Mann and Maltby.

We have seen that in Piner's case the lower margin of the lung was drawn down, and the chest flattened: all the rest would possess, more or less, similar characteristics.

In all of them, the chest, especially the sternum, was flattened, while the abdomen was somewhat enlarged.

In Scattergood, as well as Piner, the lower margin of the lung was an inch lower than it is usually: no doubt varying degrees of this permanent descent obtain.

by Professor Sharpey, which any one may repeat on himself. Pass a tape round the chest; close the glottis, so as to pre-

In all of them the walls of the chest fell backwards to an extent varying in proportion to the obstacle.

| Respiratory movement. Ordinary inspiration, where the contrary is not mentioned. | Abdomen. | | | Diaphragmatic ribs. | | Lower end of sternum. | Sixth costal cartilage. | | Upper end of sternum. | Second ribs. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | right | centre. | left. | right. | left. | | right. | left, | | right. | left. |
| Piner, æt. 27, great obstruction in the fauces and larynx | inch. ... | inch. .. | inch. ... | inch. ... | inch. ... | inch. *·50 | inch. ... | inch. ... | inch. *·12 | inch. ... | inch. ... |
| Ball — laryngitis | ... | rose | ... | ... | ... | fell | ... | ... | fell | ... | ... |
| J. Chester, æt. 13, enlarged tonsils—scarlatina | ·18 | ·0 | ·25 | ·12 | ·15 | *·14 to *·20 | *·10 to *·15 | ... | *·06 †·20 | ·30 | ·25 |
| J. Maltby, æt. 21, bronchocele: | ·18 | ·30 | ·10 | ·07 | ·06 | *·04 | *·03 | *·03 | *·03 †·005 | *·03 | *·02 |
| deep inspiration | ... | ... | ... | ... | ... | *·10 †·20 | ... | ... | ... | ... | *·10 †·70 |
| J. Mann, æt. 13, bronchocele: | ... | ·30 | ·03 | ·10 | ·09 | *·02 †·02 | *·03 | *·03 | *·02 †·05 | ·05 | *·01 †·03 |
| deep inspiration | ... | 1·00 | ... | ... | ... | ... | ... | ... | ·40 | ·40 | ... |
| A. Scattergood, æt. 16, enlarged tonsils and laryngitis: | ·12 | ·12 | ·06 | ·10 to ·15 | ·10 | *·04 †·07 | ·10 | *·01 †·06 | ·08 to ·15 | ·10 | ·06 |
| deep inspiration | ... | 1·00 | ... | ... | ... | ·50 | ... | ... | ... | 1·00 | ·70 |
| Robinson, æt. 25, obstructed nostrils and palate: | ·05 | ·15 | ·10 | ·10 | ·09 | *·06 | *·01 †·05 | *·02 | *·02 †·04 | ·10 | *·01 †·06 |
| deep inspiration | ... | ·20 | ... | ... | ... | ... | ... | ... | ·30 | ... | ... |
| Ann Slater, æt. 27, lacerated larynx, hung herself: | ·02 | ·06 | ·02 | ... | ... | *·02 | ·02 | ·02 | ·40 | ·06 | ·02 |
| deep inspiration | ·20 | ·40 | ·20 | ... | ... | *·30 | *·30 | ... | *·06 | ·60 | ·40 |
| Sarah Meads, æt. 27, chronic laryngitis | ·10 | ·20 | ·10 | ·11 | ·12 | *·04 | *·01 †·02 | *·01 †·02 | *·01 †·04 | ·05 | ·05 |
| In healthy male | ·09 | ·25 to ·30 | ·09 | ·10 | ·10 | ·02 to ·06 | ·03 to ·06 | ·02 to ·05 | ·03 to ·06 | ·03 to ·07 | ·03 to ·07 |
| In healthy female | ... | ·10 to ·20 | ... | ... | ... | ·03 to ·06 | ·02 to ·06 | ·02 to ·05 | ·06 to ·10 | ·05 to ·10 | ·05 to ·10 |

[The sign * prefixed, signifies a falling to that extent. Where no mark is prefixed, and also where the † is prefixed, a *rise* is indicated.]

In each of these cases the first line of figures indicates the movements during ordinary respiration; the second line when added shows the movement on deep inspiration.

vent the entrance of air during the inspiratory efforts, and then attempt to breathe with the diaphragm: the abdomen will protrude considerably, but the anterior walls of the chest will fall backwards, and the tape round the chest will show a diminution in circumference of from a half to one inch. In hiccough, the vocal chords are closed immediately after the beginning of a convulsive attempt at inspiration; the descent of the diaphragm and the protrusion of the abdomen is great, and the chest is elongated, narrowed, and flattened. In hysteric struggling, the vocal chords come together during inspiration, and the same respiratory movements take place, the abdomen protruding unusually, and the chest falling in.

If we lengthen a closed India-rubber bottle, containing air, the sides of it collapse; if we compress and shorten it, they swell out. So with the lungs; if they be lengthened when the air can neither escape from nor enter them, their sides will collapse; if they be shortened, their sides will swell out.

In the extreme cases, in which no air can enter the lung during the inspiratory efforts, the diaphragm descends with power, and drags down the yielding, spongy lung. The lung is considerably lengthened, and, as no air can get into it, it necessarily collapses at the side and in front, owing to atmospheric pressure. Under these circumstances, the walls of the chest are forced backwards.*

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In all the cases the thorax was flattened, narrowed or elongated, the abdomen relatively full, and the lower boundary of the thoracic viscera unusually low.

The great inspiratory action was diaphragmatic; the motion of the sternum and of many of the ribs being reversed. It was not that the costal muscles were inactive, but the contrary: for in Chester the second ribs advanced ·30 and ·25 in.; and in Maltby they fell back on tranquil respiration, but on deep inspiration they advanced ·70 in.

* "The passage of the air into and from the lung has an important effect upon the muscular respiratory movements. When a lung, or a considerable portion of it, is prevented from expanding by disease or any other cause, the pressure of the air on the inner surface of that portion of the chest covering the unexpansible lung is not now exercised during its dilatation; in other words, this portion of the chest, in expanding, must do

The force of the muscular expansion of the chest is overpowered by the superior force of atmospheric pressure. According to the degree of diaphragmatic descent and of closure or narrowing of the air-passages, is the falling back of the thoracic walls partial or universal. The falling in of the lower end of the sternum, and of the contiguous sixth costal cartilages, is, in these cases, almost invariable, unless, as in old age, the costal cartilages be ossified, when the lower end of the sternum may be protruded by the upward and forward movement of the ribs; but in this case there is usually falling in of the sixth and eighth ribs to the side.

The second ribs almost always advance, and they, in consequence, often push forward the upper end of the sternum; but, in the extreme cases, that also falls back, as in Piner, Maltby, Mann, and Slater (Table III., Cases 89, 90, 93). The following is the order in which different parts of the chest fall in, according to the extent of the diaphragmatic descent and the obstruction in the air-passages:—

When the obstruction to the entrance of air is slight, as in Scattergood, from enlarged tonsils, (Table III., Case 91,) only the lower end of the sternum falls in.

If the obstruction be a little greater, the sixth costal cartilages, in addition, fall in.

If it be still greater, as in Slater, from laceration of the larynx or trachea, (Table III., Case 93,) the upper end of the sternum, in addition, falls in.

If still greater, as in Mann, from bronchocele, (Table III., Case 90,) the fourth costal cartilages, in addition, fall in.

If still greater, as in Maltby, from bronchocele, (Table III., Case 89,) and in Piner, from obstruction in the fauces, the second costal cartilages, in addition, fall in.

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so in opposition to the whole of the atmospheric pressure on its outer surface, amounting to 15 lbs. on the square inch. This pressure appears to be too great for the muscles of inspiration, acting upon that part of the chest, to overcome, for the ribs are there motionless, or nearly so, and, if the lung is in a state of collapse, the walls of the thorax covering it fall in."—Dr. Reid, art. Respiration, Cycl. of Anat. and Phys., August 1848, p. 337.

While, in the extreme cases, all the thoracic and the intermediate ribs may collapse during inspiration, in every case the lower or diaphragmatic ribs move outwards to the normal or to an exaggerated extent. Thus in Chester, an extreme case, the diaphragmatic ribs moved outwards from ·12 in. to ·15 in., instead of ·09 in. or ·10 in. This is a striking corroboration of the purely diaphragmatic auxiliary action of those ribs.

In a patient with consolidation of the lower lobe of the left lung, and in whom there was very slight laryngeal narrowing, the whole of the thoracic expansion was diminished, but it was nowhere reversed.

It will be observed in all the cases, that, at certain parts, the same rib that falls in at the beginning of an inspiration moves forwards towards the end of it. In such instances, the first action of the diaphragm, the descent of which is sudden, is to draw down the lung more rapidly than air can rush in to supply the displaced portion of it, and the walls over the lung necessarily collapse. The diaphragm acquires almost at once its complete descent, and the lung its complete elongation and collapse; the action, however, of the thoracic ribs, at first overpowered, continues, and the lung becomes thereby gradually expanded; the reversed motion consequently speedily ceases and gives place to the usual expanding motion.

*Effect of narrowing of the air-passages on the respiratory movements during a* DEEP *inspiration.*—In the cases of Scattergood, Maltby, Mann, and Slater, it may be noticed that certain ribs that fell in during an ordinary, moved outwards to a considerable extent during a deep, inspiration; the ribs in question usually but not always fell in just at the beginning of the deep inspiration.

Mrs. Slater, before she coughed, inspired quickly and deeply, and then the falling in of the lower end of the sternum was greatly increased, and the upper end of the sternum that previously advanced then fell backwards. In all cases, if the inspiration increased in rapidity, the falling in

increased in extent, although the whole inspiration was deeper; the increased rapidity of the diaphragmatic descent causing a greater lateral and anterior collapse of the lungs and chest. When the deep inspiration is performed slowly, the ribs that recede in ordinary inspiration may advance during the whole act.

*Whatever cause* impedes the entrance of the air through the air-passages—whether obstruction in the nostrils and palate; enlarged tonsils; narrowed fauces, obstructed larynx (as in laryngitis) or trachea (as in croup and bronchocele);—may produce restrained and reversed motion of the thoracic walls during inspiration, owing to the excessive action of the diaphragm and the diaphragmatic ribs, and the consequent elongation and collapse of the lung.

*Obstruction in the right or left bronchus.*—I have not met with a case in which the right or left bronchus alone was obstructed by a foreign body, or by narrowing of the bronchus, either from disease in its walls or external pressure; but it is very evident that in such a case the motion of the ribs over the affected side will be reversed, while that of the opposite ribs and of the diaphragm will be exaggerated: indeed, this sign will indicate into which bronchus a foreign body may have fallen.

*Effect of obstruction of the air-passages on the* EXPIRATORY *movements.*—In cases of obstruction in the air-passages, the expiratory motions are usually the exact reverse of the inspiratory; that is to say, when a rib falls back in inspiration it advances in expiration; and when it first falls in and then moves forward during inspiration, it first moves forward and then falls in during expiration.

*Effect of narrowing of the air-passages on the rhythm of* RESPIRATION.—In Robinson, (obstruction in the nostrils,) the duration of the inspiration was to that of the expiration as 6 to 10.

In Maltby, (thyroid body enlarged,) it was as 5 to 8.

In Scattergood, (disease of larynx,) expiration was slower than inspiration.

In these cases the expiration was slower than the inspiration; but in that of T. Chester, a boy with enlarged tonsils, the inspiration was slow and followed by a pause, after which the expiration was performed with a gush; here the inspiration and pause seem to have been longer than the expiration.

In all the cases I have seen of obstruction to respiration arising from laryngitis, the expiration has been longer than the inspiration. The greater length of the expiration is due, I conceive, to widening of the laryngeal inlet by muscular control during inspiration, while, during expiration, the vocal chords not being drawn asunder, the outlet is narrower, and the obstruction greater. It is difficult to account for the lengthening of expiration in Robinson's case, from interruption in the nostrils, and in Maltby's, from bronchocele.

In Robinson, during expiration the abdomen fell back, quickly at first and then slowly, while the thoracic ribs moved forwards, their advance being equally slow throughout. Here the diaphragm returned suddenly at the beginning of expiration, pushing the lungs into the thoracic space more quickly than the air could escape from them. The walls of the chest were forced outwards to give increased lateral space for the shortened and thickened lung; the action, in fact, of inspiration was reversed.

The falling back during expiration of the thoracic walls at the second ribs was equally slow throughout: this was noticed both in Scattergood's case and that of a patient with condensed left lower lobe, as well as in Robinson; and this equal slowness of thoracic expiration is characteristic of obstruction in the outer air-passages. The rhythm, then, in these cases is disturbed, the expiration, which is equally slow throughout, being usually longer than the inspiration, especially in laryngitis.

In the case of enlarged tonsils, the expiration was not prolonged.

*Summary.*—Obstruction to respiration in the outer air-passages may arise from clogged and narrowed nostrils and palate, enlarged tonsils and narrowed fauces, larynx or trachea

(pp. 393-398); obstruction to respiration in one lung, from narrowed or clogged right or left bronchus. (p. 400.)

In cases where the air-passages are materially obstructed, owing to the elongation and collapse of the lungs, the chest is flattened, narrowed and elongated, the lower margins of the lungs are unusually low; from the presence of the liver, the right side is fuller than the left, and, from the collapse of the left lung in front, the heart is in great part in contact with the walls of the chest, its impulse being extensive.

The diaphragmatic descent and abdominal protrusion are very rapid and sometimes extensive, but generally the abdominal protrusion is diminished; the lungs, admitting air with difficulty, are lengthened, and, owing to atmospheric pressure, they collapse, and the sterno-costal walls, especially at the lower end of the sternum, fall backwards. (pp. 394-399.) The thoracic walls, in some places, often recede at first and then advance during inspiration. (p. 399.)

The extent of the reversed thoracic motion is in proportion to the narrowing of the air-passages and to the extent and rapidity of the diaphragmatic descent. (p. 398.)

During a deep inspiration, many parts of the thoracic walls, that fall in at the beginning of the act or during tranquil breathing, advance considerably as the expiration is prolonged. (p. 399-400.)

The inspiration is shorter than the expiration, especially in laryngitis: the expiratory falling back of the abdomen is often quick at first and then slow, but the expiratory falling back of the thoracic ribs is always equally slow throughout. (p. 400-401.)

SECT. 2.—*Effect of Obstruction in the smaller Bronchial Tubes, Bronchitis and Vesicular Emphysema, on the Movements of Respiration.*

In the cases considered in the last section, the air found its way into the lungs with difficulty, owing to obstruction to respiration in the outer passages; the lungs and chest were consequently elongated, narrowed and flattened, and they contained little air.

In *bronchitis* and *vesicular emphysema*, the outer passages are free, but there is obstruction to respiration in the smaller bronchi; and while the air enters the cells with difficulty, there is much greater difficulty to the exit of the air from the cells. The air gradually accumulates in the air-cells, which are distended, and in emphysema very greatly dilated, the whole lungs being necessarily greatly enlarged.

The chest of course partakes of the increased size of the lungs and heart. It is rounded, broad and deep, being expanded to the utmost. The dorsal curve is unusually great, and the diaphragm is also very much lowered.

*Effects of bronchitis and emphysema on the respiratory movements during ordinary respiration.*—The chest and its contents are throughout amplified to an extent greater in extreme cases than they can be in health during the deepest possible inspiration.

The heart is enlarged and lowered. The enlarged lungs spread forwards and downwards in front of the heart, occupying a great portion of the space previously occupied by that organ; they in great part cover the heart and interpose themselves between it and the sternum, ribs and intercostal spaces. A small portion of the right ventricle is in contact with the thoracic walls, immediately behind and to the left of the xyphoid cartilage. The impulse is no longer perceptible over the intercostal spaces, but is felt over, below, and to the left of the xyphoid cartilage.

The diaphragm is everywhere flattened, and is a full inch lower than it is in health.

Owing to the obstruction in the smaller bronchi, and to the chest being already almost expanded to its greatest possible extent, the efforts of inspiration, though energetic and laborious, cannot inflate the lungs to anything like the healthy degree.

*The lower end of the sternum and adjoining cartilages recede during inspiration.*—During inspiration, the diaphragm descends with great force, drawing down and elongating the inferior portion of the lungs, while the upper part of the chest moves forwards and upwards, expanding the superior por-

tion of the lungs. While the abdomen and the upper part of the chest protrude, the lower end of the sternum and the adjoining costal cartilages collapse during inspiration. The same remarkable phenomena occur that take place in extreme narrowing of the larynx; the chest falls backwards during inspiration: but, whereas in extreme cases of laryngeal obstruction the whole chest may be flattened and narrowed during inspiration, in emphysema and bronchitis the upper part of the chest always moves forward during inspiration, and it is only the lower part of the chest that recedes.

The chest collapses in bronchitis and emphysema, for the same reason that it does so in extreme laryngeal obstruction; the lungs are enlarged above and lengthened below more rapidly than air can enter them, and, owing to atmospheric pressure, they necessarily collapse below, and the walls of the chest there fall backwards. The walls of the chest at the lower end of the sternum and the adjoining cartilages recede in bronchitis and emphysema, for the same reason that they recede (though more extensively) in extreme narrowing of the larynx. The falling back during inspiration of the lower end of the sternum, and the adjoining costal cartilages, and the protrusion of the abdomen and of the upper part of the chest, is shown in the accompanying Daguerreotype views of W. Rawson, a boy aged 13, suffering from bronchitis and emphysema. In relation to this subject, I beg to refer to the explanation given in the last section, p. 394-398.

The inspiratory efforts of the diaphragm and the upper part of the chest are very great and laborious, but the inspiratory movements of these parts are far from being augmented to a corresponding extent. The abdominal movement is often lessened, and but seldom augmented, in emphysema; and although the motion of the second ribs is often somewhat exaggerated, in some cases it is not so. In every case, the inspiratory muscular efforts are much more exaggerated than the respiratory movements of the upper part of the chest. The movement of the diaphragm, during the deepest possible inspiration, is never so great as in health, its extreme descent being in the

Fig. 1.

Fig. 2.

WILL.M RAWSON. EMPHYSEMA.

Lithog.d from Daguerrectype by B. George, 54, Hatton Garden

worst cases only the third of an inch, and in milder cases two-thirds (as will be seen in the Table and analyses of cases given below);* while the inspiratory muscular efforts of the dia-

* Table referred to above:—

| | Upper portion of sternum. | Second rib. | | Abdomen. |
|---|---|---|---|---|
| | | right. | left. | |
| | inch. | inch. | inch. | inch. |
| In W. Redmill, age 46, emphysema, bronchitis—Table III., Case 101 | ·05 | ·07 | ·04 | ·30 |
| John Hart, 32, bronchitis, some emphysema, dyspnœa—Table III., Case 99 | ·02 to ·06 | ·02 to ·09 | 03 to ·12 | ·18 |
| John Worth, 30, bronchitis, emphysema—Table III., Case 102 | ·03 to ·05 | ·02 to ·05 | ·02 to ·10 | ·25 to ·35 |
| C. O'Donnell, 46, bronchitis, emphysema ... | ·07 | ·05 | ·05 | ·40 |
| W. Galloway, 46, diseased heart, emphysema, bronchitis—Second observation.—Table III., Case 98*b* | ·06 | ·12 | ·14 | ·20 |
| Geo. Simpson, 50, bronchitis—Table III., Case 97 | ·04 | ·09 to ·12 | ·09 to ·08 | ·25 |
| W. Rawson, 13, bronchitis, emphysema—Table III., 96*a* 96*b*.—See Daguerreotypes | ·04 to ·10 | ·06 to ·11 | ·12 | ·12 to ·18 |
| Second observation ... ... ... ... ... | ·03 to ·10 | ·03 to ·12 | ·15 | ·35 |
| W. Shaw, 30, emphysema, bronchitis—Table III., Case 108 | ·08 | ·10 to ·15 | ·08 to ·15 | ·45 |
| J. Shaw, 45, chronic bronchitis, slightly obstructed larynx—Table III., Case 104 | ·12 to ·20 | ·10 to ·15 | ·10 to ·15 | *5 †·23 |
| J. Linthwaite, 50, chronic bronchitis—Table III., Case 100 | ·09 to ·24 | ·10 to ·25 | ·10 to ·25 | ·10 to ·40 |
| J. Squire, 30, chronic bronchitis, emphysema—Table III., Case 95 | ·20 to ·30 | ·25 to ·26 | ·22 to ·25 | ·31 to ·50 |
| Healthy male from 10 to 45 or 50 ... ... | ·03 to ·06 | ·03 to ·07 | ·03 to ·07 | ·25 to ·30 |

The ordinary figures, and those with † prefixed, denote a forward motion during inspiration; those with * prefixed, a backward motion.

In Linthwaite, J. Shaw, and Galloway, the upward movement of the upper end of the sternum was a little more than its forward movement.

| | Linthwaite. | | J. Shaw. | | Galloway. |
|---|---|---|---|---|---|
| | Ordinary inspiration. | Deep inspiration. | Ordinary inspiration. | Deep inspiration. | Ordinary inspiration. |
| | inch. | inch. | inch. | inch. | inch. |
| The upper portion of the sternum advanced | ·09 to ·24 | ·40 | ·25 | ·90 | ·04 to ·05 |
| ,, ,, moved upwards | ·09 to ·24 | ·55 | ·30 | ·90 | ·06 |

In many of the cases, the inspiratory muscular efforts were very powerful, the supplementary muscles being called into action. The amount

phragm are unusually energetic. (With a much slighter effort, I have seen the diaphragm descend in health from one

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of motion was far from being equal to the muscular force. The resistance to the muscular effort is unusual, and resides in the costal walls, (which have already, even at the end of expiration, the dimensions produced in health by the deepest possible inspiration, their minimum being the maximum of health,) and in the minute tissue of the whole lungs.

The abdominal protrusion was above the average in—

| | Abdomen. | | | Diaphragmatic rib (10th.) | |
|---|---|---|---|---|---|
| | right. | centre. | left. | right. | left. |
| | inch. | inch. | inch. | inch. | inch. |
| W. Shaw | ·12 | ·45 | ·10 | ·01 *·03 | ·03 |
| J. Worth | ... | ·25 to ·35 | ... | ·03 | ·03 to ·10 |
| J. Squire | ·12 | ·31 to ·50 | ·12 | ·20 | ... |
| C. O'Donnell | ·06 | ·40 | ·11 | *·01 †·10 | ·11 |
| J. Linthwaite | ·07 to ·15 | ·10 to ·40 | ·07 to ·15 | ·10 to ·20 | ·10 to ·20 |
| W. Rawson, second observation | ·10 | ·35 | ... | ... | ... |

It was normal in—

| | | | | | |
|---|---|---|---|---|---|
| Redmill | ·10 | ·30 | ·10 | ·10 | ·10 |
| Simpson | ·10 | ·25 | ·10 | ·10 | ·06 |

And was lessened in—

| | | | | | |
|---|---|---|---|---|---|
| W. Galloway, first observation | ·08 | ·20 | ·12 | ·03 | ·08 |
| Second observation | ·06 | ·20 | ·05 | ·015 | ·015 |
| J. Hart | ·08 | ·18 | ·09 | ·04 to ·06 | ·04 |
| John Shaw | ·02 to ·03 | *·05 †·23 | ·02 to ·03 | ·08 to ·10 | ·08 to ·10 |
| W. Rawson, first observation—worst | ... | ·12 to ·18 | ... | ·10 | ·12 |
| Health | ·09 | ·25 to ·30 | ·09 | ·10 | ·10 |

The ordinary figures, as also those with † prefixed, denote a forward movement to that extent; those with * prefixed, a backward movement, during inspiration.

In all these cases the muscular action was much exaggerated, but especially in those where the abdominal motion was diminished.

Rawson, an interesting boy of 13, (whose daguerreotypes, were taken first in the tranquil state and then during a deep inspiration,) illustrates this point well. When he was first observed, he had, in addition to habitual enlargement of the lungs, a severe attack of bronchitis; the

to two inches.) The muscular efforts are more powerful in proportion to their inefficiency and to the severity of the disease.

In all the cases the diaphragmatic action was exaggerated, but especially in those where the abdominal motion was diminished. This is well illustrated by the case of Rawson, detailed below. When first examined, he suffered from a severe attack of bronchitis, with emphysema; the diaphragmatic efforts were very laborious, but the abdominal movement was only half the healthy amount, being ·12 to ·18 in.; when observed a second time, after the disappearance of bronchitis, the abdominal movement was ·35 in., while the diaphragmatic effort was inconsiderable. This diminution of abdominal protrusion with manifestly increased diaphragmatic effort, allies in this respect emphysema and bronchitis, with cases of extreme laryngeal obstruction, in which the same phenomena present themselves.

The falling back of the lower end of the sternum and the

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dyspnœa was extreme: at this stage, when the respiratory muscles were strained to the utmost, the abdominal protrusion was only ·12 to ·18 in., while during the second observation, made a month later, when the bronchitis had nearly ceased, the abdominal protrusion was above the average, being ·35 in.

In John Shaw, in whom respiration was very difficult, it will be seen that the abdomen fell back at the beginning of the inspiration, and then moved forward. In this man the entrance of air had a double difficulty in the smaller bronchial tubes and in the obstructed larynx. The falling in of the abdomen at the beginning was due, I conceive, to the lateral expansion caused by the excessive action of the diaphragmatic ribs, the outward movement of which was ·08 to ·1 in., while that of the abdomen at the sides was only ·02 to ·03 in.

It will be observed that in John Shaw, whose muscular efforts were very powerful, and whose abdominal protrusion was the greatest, being ·45 in., the lateral motion of the abdomen was only ·02 to ·03.

This diminution of abdominal protrusion with manifest increase of diaphragmatic effort allies the cases now under review to those in which the outer air-passages were obstructed. By referring to the table of those cases, it will be seen that in most of them the abdominal protrusion was lessened,—in Slater, it was only ·06, while the diaphragmatic action was rapid and exaggerated. In Piner, in whom the obstruction was the greatest, the abdominal protrusion, judging by the eye, was considerable.

adjoining part of the chest is more extensive and greater in amount, in proportion to the amount of obstruction in the smaller bronchi, the energy and inefficiency of the inspiratory musular efforts, and the flexibility of the costal cartilages.*

In the slighter cases the lower end of the sternum recedes only at the beginning of inspiration. The descent of the diaphragm is very rapid at first, a portion of lung is displaced downwards, and, as air cannot enter with sufficient rapidity, the lower parts of the lungs collapse, and the lower end of the sternum is forced back by atmospheric pressure just at the

* The amount of falling back will be seen in the individual cases:—

| Cases. | Lower end of sternum. | Sixth costal cartilage. | | Fourth costal cartilage. | | Eighth rib. | Central abdomen. | Second rib. | |
|---|---|---|---|---|---|---|---|---|---|
| | | right. | left. | right. | left. | | | right. | left. |
| Jos. Squire, æt. 30 | inch<br>*·12 | inch.<br>*·6 †·24 | inch.<br>*·10 †·33 | inch.<br>·22 to ·25 | inch.<br>·22 to ·25 | inch.<br>... | inch.<br>·31 to ·50 | inch.<br>·25 to ·25 | inch.<br>·22 to ·25 |
| Rawson, æt. 13. See Daguerreotypes. | *·3 to *·06 | *·07 | *·05 | *·02 †·05 | *·01 †·03 | ... | ·12 to ·18 | ·06 to ·11 | ·12 |
| Second observation | *·08 | *·10 | *·03 †·02 | ·03 to ·09 | ·11 | ... | ·35 | ·03 to ·12 | ·15 |
| G. Simpson, æt. 50, bronchitis. | *·05 | *·02 †·03 | *·04 | *·03 | *·03 | ... | ·25 | ·09 to ·12 | ·08 to ·10 |
| W. Galloway, æt. 40, emphysema, diseased heart, bronchitis. | *·03 | *·03 | *·03 | *·03 | *·01 †·04 | ... | ·20 | ·12 | ·14 |
| Last observation. | *·04 to *·15 | *·02 †·04 | *·04 †·04 | *·02 †·02 | *·03 †·02 | ... | ·20 | ·08 | ·12 |
| J. Hart, æt. 32. | *·01 to *·04 | ·05 | ·05 | ·01 to ·03 | ·03 to ·09 | ... | ·18 | ·02 to ·09 | ·03 to ·12 |
| J. Linthwaite, æt. 50. | *·02 †·06 | *·01 †·10 | *·02 †·08 | ·08 to ·12 | ·06 to ·10 | ... | ·10 to ·50 | ·10 to ·25 | ·10 to ·25 |
| W. Redmill, æt. 46. | *·02 | ·02 | ·03 | ·03 | 0 | ... | ·30 | ·07 | ·04 |
| J. Worth, æt. 30. | *·01 †·03<br>*·005 †·03 | ·03 | ·04 to ·12 | ·01 | ·0 to ·05 | ... | ·25 | ·02 to ·05 | ·02 to ·10 |
| J. Shaw, æt. 45. | ·10 to ·12 | ·15 | ·12 | ·12 | *·03 †·07 | ... | *·05 †·23 | ·10 to ·15 | ·10 to ·15 |
| W. Shaw, æt. 30. | ...<br>·04 | ...<br>*·01 | ...<br>*·01 †·01 | ...<br>*·03 | ...<br>*·01 †.02 | ...<br>r. l.<br>*·08 *·07 | ...<br>r. c. l.<br>·12 ·45 ·10 | ·10 to ·15<br>Teeth rib.<br>·01 *·03 | ·03 to ·15<br>·03 |
| C. O'Donnell, æt. 44. | ·06 | *·03 †·03 | *·01 †·06 | *·01 †·03 | *·01 †·04 | ... | ·06 ·40 ·11 | | |

The ordinary figures, and those with † prefixed, denote a forward movement to that extent; those with * prefixed, a backward movement, during inspiration.

We see from the actual observations, that, excepting the two Shaws and O'Donnell, the lower end of the sternum fell back either during the whole inspiration or at the beginning of it, and that the sixth cartilages fell in, especially on the left side in the neighbourhood of the heart, in nearly all

beginning of the inspiration. As the inspiration proceeds, the portion of lung which at first collapses, gradually expands, and towards the end of inspiration the lower end of the sternum moves forward in common with the rest of the anterior thoracic walls.

1st stage.—If the case be slight, the lower end of the sternum falls back only at the beginning of inspiration and then advances.

2nd.—If the case be somewhat more severe, the lower end of the sternum alone falls back through the whole of the inspiration.

3rd.—If the case be still more severe, the sixth costal cartilages fall back in addition to the lower end of the sternum.

4th.—And in the most severe cases, in addition the fourth costal cartilages fall back.

If the case under observation grows worse, the amount and extent of the falling back increases, according to the stages just given; while, if the case improves, the extent of the collapse of the chest diminishes, as in the boy Rawson, in whom, at the first observation, the lower end of the sternum and the sixth and fourth costal cartilages receded; and at the second

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those cases; the amount of retraction of the sixth cartilages bearing a proportion to that of the lower end of the sternum.

During inspiration—

| | |
|---|---|
| In Worth and Linthwaite | The lower end of the sternum fell back at the beginning and advanced towards the end of the act. |
| In Worth, Redmill and Hart | The lower end of the sternum alone fell back. |
| In Galloway (1st observation), Squire, Rawson (2nd observation), and Linthwaite | In addition, the sixth costal cartilage fell back. |
| In Rawson (1st observation), Galloway (2nd observation), (they were then worse,) and Simpson | In addition, the fourth costal cartilage fell back. |

These observations show that a greater number of cartilages fall back in the same case when the patient gets worse, as in Galloway, and a less number when he improves, as in Rawson; thus we are afforded a test of the progress of the case.

observation, when he was improving, the fourth costal cartilage no longer fell in, while the sixth did so. We are thus afforded a test of the favourable or unfavourable progress of the case.

*In some cases, the lower end of the sternum,* instead of falling backwards, *protrudes during inspiration*; and in these cases *the lower part of the chest,* instead of being flattened, *is narrowed during inspiration.**

* Cases in which the lower end of the sternum protrudes during inspiration :—

In William Shaw and O'Donnell the lower end of the sternum did not fall in, but moved forwards, during inspiration. In Shaw the whole of the lower part of the chest, from the sixth rib down to the eighth, became narrowed during inspiration, the sixth ribs falling in ·01 in., but the eighth ribs as much as ·08 and ·07 in. In Shaw the dorsal curvature, which always exists, to a greater or less extent, in the emphysematous, was unusually great, the lower end of the sternum unusually prominent: the sixth and seventh costal cartilages and ribs advanced somewhat after a boat-shape, and as the rib and cartilage yielded inwards during inspiration, when they were raised they pushed forward the lower end of the sternum, as we have already observed to be the case in rachitic children. (pp. 375-376.)

The great dorsal curvature would also tend to throw forward the lower end of the sternum, as has been already remarked. (pp. 378-379.)

O'Donnell, aged 46, is a less marked illustration of the same thing; in him the fourth and sixth cartilages fell in slightly while the lower end of the sternum protruded. In this case the cause resided in the firmness of the costal cartilages.

In John Shaw, aged 46,—the other man in whom the lower end of the sternum advanced, but who differed from O'Donnell and William Shaw in that, except the left fourth costal cartilage, none of the cartilages or ribs receded,—the firmness of the ribs and costal cartilages was the manifest cause of the want of falling in. In John Shaw alone did the abdomen fall back at the beginning of inspiration; and in him the centre of the diaphragm evidently yielded in the struggle: in the other cases, the abdomen advanced and the sternum or ribs fell in; in him the ribs advanced and the abdomen fell in.

Linthwaite, aged 50, connects the cases in which, during inspiration, the lower end of the sternum receded with those in which it protruded; in him the lower end of the sternum and the sixth cartilage only receded ·02 in., and then advanced ·08 in. With the exception of this trifling retraction at first, Linthwaite's case exactly tallied with John Shaw's; and this difference disappeared in John Shaw after a prolonged examination, when the dyspnœa

In these persons the sixth, seventh and eighth ribs (the intermediate set), from acquired deformity, are hollow at the side, at the place of junction of those ribs with their cartilages; the sternum is prominent, and the lower part of the chest is deep and narrow. The sixth, seventh and eighth ribs fall in at the sides during inspiration close to their costal cartilages, and the lower end of the sternum, in consequence, projects considerably.

*In certain cases, no part of the thoracic walls falls in during inspiration.*—In some persons, rather advanced in life, the costal cartilages are stiff and unyielding; and in them the chest, instead of receding anywhere, may advance throughout, as in health. In one such case, the abdomen, instead of the lower end of the sternum, was retracted at the beginning of inspiration. The abdominal retraction was evidently caused by the thoracic expansion, in the same way that the usual thoracic retraction is caused by the abdominal protrusion.

In some cases of this class the lower end of the sternum and the adjoining cartilages fall back slightly, just at the beginning of inspiration, and then advance; and in other cases although the thoracic walls may not fall back, yet they stand still just at the beginning of the inspiration. This standing still of the thoracic walls is, if I may so speak, the first stage of their falling back.

In those cases of emphysema and bronchitis in which the thoracic walls recede over the lower end of the sternum and the adjoining costal cartilages, the costal walls at the upper part of the chest usually stand still just at the beginning of inspiration, and then advance. This pause at the beginning of the inspiratory movement of the upper part of the chest is due to the same cause as the collapse of the lower part of the

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increased; for then the lower end of the sternum fell back ·03 in., before advancing. In Linthwaite, the movements, like those of John Shaw, were modified by the stiffness of the costal cartilages. This point will be further illustrated in considering the influence of old age in modifying the respiratory movements in those affected with emphysema.

chest, namely, the obstruction to inspiration, which is indeed greatest at the beginning of the act.

*The intercostal spaces fall in during inspiration.*—In applying the chest-measurer in the examination of persons affected with emphysema, care must be taken to place the instrument, not over the intercostal spaces, but over the rib. In emphysema the intercostal spaces fall in very notably during inspiration, as Dr. Stokes, Dr. C. J. B. Williams and others have noticed; so much so, that in Galloway, while the sixth rib moved outwards ·04 to ·09 in., the fifth intercostal space retracted ·08 in. This retraction of the intercostal spaces is present where they are over lung, but not where they are over liver. Thus the exact inspiratory descent of the lung can be observed by the eye; the intercostal retraction stops short at the liver and, in a less marked manner, at the stomach; as the lungs, during inspiration, replace those organs, the intercostal retraction extends *pari passu*.

The intercostal retraction over the lung is seen in health during a deep inspiration in all persons not overloaded with fat.

*The head is lowered during an ordinary inspiration* in emphysema and bronchitis, as well as in all other cases of dyspnœa, whether the person be standing, recumbent, or lying on the side, in which last attitude the motion is usually greatest; in each of the Shaws and in Linthwaite the head was lowered from ·02 in. to ·03 in., and in one case ·05 in.

*The expiratory movements in bronchitis and emphysema.*—The expiration, except that it is so prolonged, is usually the exact reverse of inspiration. While, during inspiration the lower part of the chest first recedes and then advances, during expiration that part first advances and then recedes: but sometimes the advance of expiration is much greater than the falling back of inspiration. Thus in one case, J. Shaw, towards the end of the examination, when the lower end of the sternum, during inspiration, fell back ·03 in. and advanced ·04 in., it advanced ·1 in. and fell back ·08 in. during expiration.

The advance of the lower end of the sternum during expiration is due to the quick ascent of the diaphragm, which pushes the lungs suddenly upwards.

As the air in the lungs can only escape with difficulty, their lateral diameter is increased and the lower end of the sternum is driven forwards during expiration as much as, or even more than, it falls back during inspiration. As a pause over the upper part of the chest often takes place at the beginning of inspiration, so a like pause, as in Hart's case, often occurs at the beginning of expiration.

*Effect of obstruction in the smaller bronchial tubes on the* RHYTHM *of respiration.*—The duration of expiration is invariably longer, and in many cases much longer, than that of inspiration. The greater the obstruction, the more prolonged is the expiration. The prolongation of expiration is a long recognized and important sign in bronchitis and emphysema. To estimate the exact relative duration of inspiration and expiration, I beat time very rapidly with the finger and count the beats, first during inspiration, and then during expiration; this plan, or simply counting, tells with accuracy the relative duration of the acts.

The duration of inspiration to that of expiration was, in

| | |
|---|---|
| J. Shaw | 4 to 13 |
| W. Galloway, 1st examination | 4 to 8 |
| Do. 2nd examination, when the obstruction was greater | 4 to 12 |
| W. Rawson, 1st examination | 3 to 8 |
| Do. 2nd examination, when the obstruction was less | 6 to 9 |
| W. Shaw | 4 to 9 |
| J. Linthwaite | 4 to 9 |
| J. Hart | 4 to 8 |
| J. Worth | 5 to 9 |
| J. Squire | 4 to 6 |
| G. Simpson | 4 to 4 or 5 |

The prolongation of expiration is invariable, and it is a measure of the amount of obstruction to respiration—in Rawson, as the obstruction diminished, the expiration shortened;

and in Galloway, as the obstruction increased, the expiration lengthened. The act of expiration is always prolonged, and, which is the important feature in obstruction in the bronchial tubes, it becomes gradually slower towards the end. After abdominal expiration has ceased, thoracic expiration continues for a short time. The cause of the prolonged expiration is apparent.

During inspiration the beginning of the act is spent in enlarging the larger tubes, which expand readily; and in dilating the lesser ones, which, being then smaller, offer greater obstruction to respiration at the beginning than the end of inspiration. This is one reason for thoracic respiration being slower at the beginning of inspiration. Afterwards, as inspiration progresses, the tubes become wider and admit air more freely. The mucous or sonorous rhonchus, if slight, is often present only at the beginning of inspiration, when the entrance through the smaller air-tubes is most obstructed. If the rhonchi be continuous, they are less grave at the beginning than the end of the inspiration.

During expiration the physical conditions are reversed, the air-tubes being all at their largest at the beginning of the act. At first the air rushes out easily from the larger bronchi; as the expiration advances, the smaller tubes diminish, and the mucus they contain fills them more completely. The difficulty to the exit of air from the air-cells is necessarily increased. If sonorous rhonchi be present, they are often, at first, grave: but they gradually rise in pitch towards the end of the act. In such cases the expiration is prolonged, and becomes slower in exact proportion to the increased obstruction in the finer air-tubes. In some cases interrupted rhonchi are accompanied by interrupted expiratory movements.

Whenever, and from whatever cause, the air-tubes, large or small, are clogged with fluid, they obstruct both inspiration and expiration; but the obstruction tells most on the expiration, which is, under these circumstances, at first rapid and then slow, becoming always progressively slower towards

the end. The rapid movement at the beginning is chiefly manifested on the abdomen, the slow movement towards the end, on the walls of the chest.

The rapidity of the expiration at first, and its increasing slowness towards the end, characterizes obstruction in the bronchi from obstruction in the larynx, as in the latter case: the prolonged expiration is equally slow throughout.

While examining a case of bronchitis, I have observed the expiration, previously of increasing slowness, to become suddenly equally slow throughout. This was traceable to the rapid accumulation of sputa between the vocal chords obstructing the larynx. As soon as the larynx was cleared by coughing, the increasing slowness of the expiration towards the end returned.

In simple bronchitis and simple emphysema, the expiration is not so much prolonged as it is when they are combined. In Rawson's case this was well illustrated—as the bronchitis lessened, the emphysema alone acted, and the expiration was not so much prolonged.

The duration of the expiration varies, in these compound cases, with the varying obstruction in the smaller bronchial tubes.

The expiration is, I conceive, not so much prolonged when the obstruction is seated in the larger bronchial tubes, as it is when in the smaller. The cases of Simpson and Eaton, in whom the expiration was not materially lengthened, are examples of this.

In emphysema and bronchitis, owing to the protrusion, during inspiration, of the abdomen and of the upper part of the chest, and the collapse of the lower end of the sternum and the adjoining cartilages, the rhythm of the movements of respiration is different over the abdomen, the upper part of the thorax, and the lower end of the sternum.

Over the *abdomen*, the *inspiratory* protrusion is quick, and equal throughout. During *expiration*, the abdomen retracts very rapidly and extensively just at first, and then falls back very slowly. Sometimes there is a short pause after the first

expiratory movement. After this pause, the abdomen again recedes, though very slowly, and often with two or three interruptions. Abdominal expiration often ceases before thoracic expiration.

Over the *upper part of the thorax*, during *inspiration*, there is, at first, often a pause, or the ribs and sternum move forward slowly at first, and then advance more rapidly and at an equal rate. During *expiration* the upper part of the chest generally pauses just at first; it then moves rather quickly, and afterwards very slowly, becoming gradually slower towards the end. Sometimes there is interrupted thoracic expiration. The thoracic expiration is often prolonged after the abdominal expiration ceases.

The *lower end of the sternum* and the contiguous cartilages, during *inspiration*, either recede throughout, as has been already stated, or fall in at the beginning and then move forward, or only pause at the beginning and then advance. During expiration the movements of the lower end of the sternum are the reverse of those during inspiration. Sometimes when the sternum stands still during inspiration, its motion is reversed at the beginning of expiration.

The characteristic feature of the rhythm of respiration in emphysema is this, that the expiration is quick at first, then slow, becoming gradually slower towards the end.

*Effects of obstruction of the smaller bronchial tubes on the movements of respiration during a* DEEP *inspiration.*—I have only observed the extreme inspiratory movements in a few of the cases, and at a few points, the condition of many of the cases precluding the inquiry.

As a general rule, the extreme inspiratory movements were much restrained, and sometimes in part reversed where they were reversed in ordinary breathing.

| | Extreme breathing capacity. | Inspiration. | Upper portion of sternum. | Second rib. | | Abdomen. | Lower end of sternum. | Sixth cartilage. | | Eighth rib. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | right. | left. | | | right. | left. | right. | left. |
| | inches. | | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. |
| W. Shaw | 90 | ordinary | ·08 | ·10 to ·15 | ·08 to ·15 | ... | ·04 | | | | |
| | | deep | ... | ·25 | ·25 | ... | ·23 | | | | |
| W. Rawson | ... | ordinary | ·04 to ·10 | | | | | | | | |
| | | deep | ·30 | | | | | | | | |
| Second observation (better) | ... | ordinary | ·03 to ·10 | ... | ... | ·35 | *·08 | | | | |
| | | deep | ·50 | ... | ... | ·50 | *·08 †·20 | | | | |
| Redmill | ... | ordinary | ·05 | ·07 | ·04 | ·30 | *·02 | | | | |
| | | deep | ·25 | ·35 | ·30 | ·50 | *·03 †·30 | | | | |
| Simpson | ... | ordinary | ·04 | ·09 to ·12 | ·09 to ·08 | ·25 | | | | | |
| | | deep | ·50 | ·30 | ·30 | ·35 | | | | | |
| Linthwaite | 155 | ordinary | ·09 to ·24 | ·10 to ·25 | ·10 to ·25 | ·1 to ·40 | *·02 †·08 | *·01 †·10 | *·02 †·08 | | |
| | 140 | deep | ·40 | ·50 | ·40 | ·70 | *·02 †·20 | *·01 †·20 | *·02 †·17 | | |
| | | | | | | | *·02 †·35 | | | | |
| John Shaw | 120 | ordinary | ·12 to ·20 | ·10 to ·15 | ·10 to ·15 | *·005†·23 | ·10 to ·12 | ... | ... | ·10 | ·10 |
| | 190 | deep | ·55 | ·90 | ·80 | ·80 | ·50 | ... | ... | ·45 | ·40 |
| J. Worth | 230 | ordinary | ·03 to ·05 | ·02 to ·05 | ·02 to ·10 | ·25 | *·005†·03 | | | | |
| | | deep | ·70 | 1·10 | 1·10 | ·70 | *·02 †·60 | | | | |
| Health | ... | ordinary | ·03 to ·06 | ·03 to ·07 | ·03 to ·07 | ·25 to ·30 | ·02 to ·06 | ·02 to ·06 | ·02 to 05 | ·08 | ·08 |
| | | deep | 1·0 | 1·10 | 1·10 | 1·0 | ·90 | ·80 | ·70 | ·65 | ·65 |

The ordinary figures, and those with † prefixed, denote a forward motion; those with * prefixed, a backward motion of the costal walls during inspiration.

From these scanty materials we may conclude that the extreme motion is, in many cases, very materially diminished: thus in Shaw it was only ·25 and ·35 in. at the second rib, instead of being from ·80 to 1·00 inch.

That as the obstruction diminishes, the extreme motion increases. Thus in Rawson, during the first examination, the extreme motion of the upper end of the sternum was ·3 in.; during the second, when there was less obstruction, ·5 in.

That the extreme motion is a test of the extreme breathing-capacity. Thus in William Shaw, whose capacity was only ·90 cub. in., the extreme movement of the second ribs was only ·25 cub. in.; while in Worth, whose capacity was ·230 cub. in., the extreme movement was 1·00 cub. in.

That where the breathing-capacity of the lung is considerable, but the obstruction great, the deep inspiration and expiration are slow. In Shaw, although the capacity and motion were considerable, the deep inspiration and expiration were very slow. Shaw's case was complicated by obstruction in the larynx.

That when the lower end of the sternum or a costal cartilage falls back and then rises during an ordinary inspiration, it also does so during a deep inspiration; as—

| | | The lower end of the sternum | | | |
|---|---|---|---|---|---|
| | | inch. | | | inch. |
| In Linthwaite, during an ordinary inspiration . . | receded | ·02 | and advanced | | ·08 |
| In Linthwaite, during a deep inspiration . . . | ,, | ·02 to ·05 | ,, | | ·20 to ·35 |
| In Worth, during an ordinary inspiration . . . | ,, | ·005 | ,, | | ·03 |
| In Worth, during a deep inspiration . . . | ,, | ·02 | ,, | | ·60 |

That when the lower end of the sternum recedes throughout during an ordinary inspiration, it recedes at the beginning of a deep inspiration, and then advances, in proportion to the breathing-capacity: thus—

| | | | | | inch. | | inch. |
|---|---|---|---|---|---|---|---|
| In Rawson, the sternum in | ordinary | inspiration | receded | | ·08 | and advanced | 0 |
| ,, ,, | full | ,, | ,, | | ·08 | ,, | ·20 |
| In Redmill, ,, | ordinary | ,, | ,, | | ·02 | ,, | 0 |
| ,, ,, | full | ,, | ,, | | ·03 | ,, | ·30 |

That when the lower end of the sternum advances, while the ribs fall in to the side, during an ordinary inspiration, it also advances, and to an increased degree, during a deep inspiration: thus—

| | | | |
|---|---|---|---|
| In William Shaw, the lower end of the sternum during | ordinary inspiration, advanced | . | ·04 in. |
| ,, ,, | deep ,, ,, | | ·23 |

That when the lower end of the sternum advances, from stiffening of the cartilages, during an ordinary inspiration, it also advances during a deep inspiration, and to a greater degree; and that in such a case the increased lateral expansion of the lower ribs is not proportioned to that of the lower end of the sternum: thus—

| | | | | |
|---|---|---|---|---|
| | | inch | | inch. |
| In John Shaw, while the second rib advanced | from | ·1 to ·15 | in ordinary and | ·9 on a deep insp. |
| the eighth rib moved outwards | ,, | ·1 | ,, | ·45 ,, |

That when the deep inspiration is involuntary and almost convulsive, as it is when preceding a cough, it is very rapid;

and from the rapid descent of the diaphragm, those parts of the chest may recede much that only recede a little during an ordinary inspiration: thus—

In Galloway, the lower end of the sternum fell back during an ordinary inspiration . . . . . } ·04 in. to ·15 in.

And it fell back during the rapid deep inspiration preceding a cough . . . . . } ·2 in.

*Effects of obstruction in the smaller bronchial tubes on the respiratory movements in* OLD AGE.—In old age, the cartilages, being ossified, form with the rib one unyielding piece: and in consequence, the lower end of the sternum, instead of falling in, moves forward during inspiration, as we see in—

| | Upper end of sternum. | Second rib. | | Lower end of sternum. | Sixth cartilage. | | Eighth rib. | | Abdominal protrusion. | Rhythm. Insp. to Exp. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | right. | left. | | right. | left. | right. | left. | | |
| | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | insp. to exp. |
| T. Eyre, æt. 75. | *·02 †·03 | *·05 †·05 | * 01 †·02 | ·06 | ·07 | ·06 | ·04 | ·04 | ·35 | 4 : 8 |
| W. Flinders, æt. 69. | ·08 | ·04 | ·07 to ·10 | ·09 | ·07 | ·06 | ·06 | ·12 | ·60 | 6 : 9 |
| T. Thompson, æt. 69. | ·06 | ·07 to ·08 | ·10 | *·01 to †·06 | *·04 † 02 | *·02 †·06 | *·02 †·06 | *·03 †·06 | ·10 | 4 : 8 |
| Deep inspiration. | ... | ... | ... | ·13 | ... | ... | *·10 | *·12 | | |
| Health in old age, about the average. | ·02 to ·06 | ·02 to ·06 | ·02 to ·06 | ·03 to ·07 | ·03 to ·07 | ·03 to ·07 | ·05 to ·10 | ·05 to ·10 | ·25 to ·35 | 4 : 5 or 6 |

The ordinary figures, and those with † prefixed, denote a forward motion; those with * prefixed, a backward motion of the costal walls during inspiration.

In Eyre, (Table III., Case 109,) and Flinders, (Table III., Case 110,) the deviation from the normal state was not material (I do not know the cause of the slight falling back of the upper portion of the sternum at the beginning of the inspiration in Eyre). The lower end of the sternum moved forwards somewhat more than the average, and the sixth rib moved outwards somewhat less. In both of these, but especially in Flinders, the abdominal movement was excessive.

In Thompson (Table III., Case 111) alone, of the three, was there the slightest recession of the lower end of the sternum and its adjoining cartilages, and in him they only receded at the beginning of the inspiration, while on a deep inspiration they did not recede at all. It will also be observed that the eighth rib fell inwards at the beginning only of an ordinary, but during the whole time of a deep, inspiration. In this respect his case may be compared with that of W. Shaw, (p. 410,) in whom, while the lower end of the sternum advanced, the eighth ribs fell inwards during each inspiration.

The rhythm of respiration is changed in old age as it is in the adult.

*Effects of obstruction in the smaller bronchial tubes on the movements of respiration in* THE FEMALE.—The great development of the superior thoracic, and the restraint on the intermediate and diaphragmatic, ribs, due to the wearing of stays, causes in the female a considerable variety in the effects of emphysema on the position of the viscera, the form of the chest and abdomen, and the movements of respiration.

| | Sternum, upper end. | Second rib. | | Sternum, lower end. | Sixth costal cartilage. | | Eighth rib. | | Abdomen. | Rhythm. Insp. to Exp. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | right. | left. | | right. | left | right. | left. | | |
| | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. |
| Mary Cross, 14, recovering from bronchitis, fever | ·05 | ·03 to ·05 | ·03 to 05 | *·02 | *·01 | *·02 | ·03 | ·02 | ·15 | 4 : 6 |
| deep inspiration | ·06 | ·14 | ·12 | *·02 †·05 | ... | ... | ... | ... | ·50 | |
| S. Chamberlain, 20, acute bronchitis, fever | ·25 | ·12 | ·12 | *·02 †·08 | ·07 | ·08 | ... | ... | ·50 | |
| M. Elliott, 50, emphysema, bronchitis | ·15 | ·12 | ·15 | *·06 | *·02 †·06 | *·02 †·06 | ... | ... | 02 to ·06 | 4 : 7 |
| Mrs. Cooper, 30, bronchitis | ·12 | ·20 | ·20 | ·20 | *·08 | *·10 †·08 | *·06 †·08 | *·12 | ·40 | 3 : 9 |
| S. Henson, 70 | ·15 | ·25 | ·20 | ·09 | ·06 | ·08 | ·15 | ·18 | ·15 | 4 : 6 |
| Health, stays off | ·06 to ·10 | ·05 to ·10 | ·05 to ·10 | ·03 to ·06 | ·02 to ·05 | ·02 to ·05 | ... | ... | ·10 to ·20 | 4 : 5 |

The ordinary figures, and those with † prefixed, denote a forward movement; those with * prefixed, a backward movement of the costal walls during inspiration.

The point in which the respiratory movements of the male and female when affected with obstruction in the smaller air-tubes principally differ is the greatly exaggerated motion of the thoracic ribs.

M. Cross, (Table III., Case 113,) a young person recovering from a severe attack of fever and bronchitis, is the only exception; and in her, if the examination had been made a few days earlier, if my eye and recollection do not deceive me, the movements would have been exaggerated also. The above cases illustrate all the principal varieties met with in man.

In Cross, Chamberlain, (Table III., Case 114,) and Elliott, (Table III., Case 115,) the lower end of the sternum receded, as in the majority of adult males.

In Cooper, (Table III., Case 116,) the lower end of the sternum advanced considerably, and the sixth and eighth ribs fell in on each side, as in the case of Wm. Shaw. (p. 410.)

In Mrs. Henson, (Table III., Case 119,) aged 70, the ribs did not yield anywhere, as in John Shaw, p. 410, and the males arrived at old age. (p. 419.)

The rhythm of respiration is changed in females exactly as it is in males.

*Effects of obstructed bronchial tubes on the respiratory movements in* CHILDREN.—In children affected with bronchitis or hooping-cough, the chest is usually very full and rounded above and in front, the sternum arched, and the dorsum much curved; the lungs are usually elongated, the diaphragm being low; the lower end of the sternum and the lower costal cartilages are depressed. The abdomen is usually full.

In healthy children, unless the abdomen be small and the respiratory movements slight, as has been already stated, the lower part of the thorax retracts during inspiration; the retraction taking place in *healthy* children at the lower end of the sternum and the lower costal cartilages in front; but in *ricketty* children the whole sternum advances, while the lower ribs at the side fall in. (p. 375.)

This is indeed the counterpart of the effects of obstruction in the bronchial tubes on the respiratory movements of the adult.

In children affected with bronchitis and hooping-cough the same phenomena of both classes are present, only the respiratory movements of the upper part of the thorax and of the abdomen are exaggerated; and the receding of the sternum in well-formed children, and the lateral falling in of the lower ribs, with advance of the sternum, in ricketty children, are increased.

It is very difficult to observe the respiratory movements in children; but I have succeeded in examining, in more or fewer points, the respiratory movements in seven children affected with bronchitis, and in five with hooping-cough. I beg to refer to the Table containing them for the particular movements.

It will be observed that the lower end of the sternum protruded, and the lower ribs fell in at the sides, in Lowe, (Table III., Case 125,) Garner, (Table III., Case 127,) and a child with hooping-cough, (Table III., Case 129,) that the ribs did not fall in anywhere in Garton, (Table III., Case 126,) and that the lower end of the sternum and the adjoining cartilages fell back in the remaining eight children. In hooping-cough the form of the chest, position of viscera, and movements of respiration, are the same as in bronchitis. During the hooping inspiration previous to the cough, the vocal chords come in contact and separate repeatedly, giving rise to the inspiratory vocal noise. During the hooping inspiration the whole chest falls in much more than it does in the ordinary inspiration; in fact, obstructed larynx is joined to obstructed smaller bronchi to modify the inspiratory movements.

None of the cases referred to in this section died; but I believe the diagnosis is correct in all the cases. To one point, the enlargement of the lungs, I can speak with absolute certainty.*

*Summary.*—In emphysema, and, to a less extent, in bron-

* Since writing the above passage, W. Galloway (Table III., Case 98*a*, 98*b*,) died. The autopsy evidenced emphysema (with bronchitis) and great enlargement of the heart.—August 1848.

chitis, the form of the chest and abdomen and the position of the viscera are the same that they are during the deepest possible healthy inspiration.

The chest is full and prominent, the shoulders raised, the spine curved, the sternum forward, the costal cartilages at each side of it full, but not so prominent as usual. The diameter of the chest is everywhere increased, the opposite seventh costal cartilages below the sternum are stretched far apart.

The abdomen just below the prominent xyphoid cartilage is unusually hollow; the diaphragm is low and flat; the lower boundaries of the lungs and heart are a full inch lower than in the normal state. The heart is nearly covered with lung, the exposed portion of it, and consequently its impulse, being below the sternum, behind and to the left of the xyphoid cartilage.

During inspiration the diaphragm descends only from one-third to two-thirds of an inch, and the lower boundaries of the lungs and heart, and the upper boundaries of the abdominal organs, necessarily descend to the same extent. The cardiac region is lowered and lessened, the impulse becoming stronger and lower. The respiratory muscular actions are much exaggerated, while the movements are not proportionally, often not at all, increased. (p. 404.)

The diaphragm descends, the abdomen protrudes, and the superior thoracic (first, second, third and fourth) ribs ascend and advance with energy; at the same time, the lower end of the sternum and the sixth cartilages fall backwards in the greater number of cases, from childhood to the age of 50. (p. 404.)

The lower end of the sternum falls back because the exaggerated action of the diaphragm and of the upper thoracic ribs expands the lungs above, and elongates them below, more rapidly than air can rush in to fill them up; consequently they collapse intermediately, and the lower end of the sternum and the intermediate ribs (sixth, seventh and eighth) are forced backwards by atmospheric pressure. (p. 404, 894.)

In some the lower end of the sternum is prominent, and the lower part of the chest narrow and deep; in these, whatever their age and sex, the lower end of the sternum advances and the sixth and eighth ribs and cartilages fall in at the side.

In general, the lower part of the chest is flattened, but in these it is narrowed and deepened during a deep inspiration. (p. 410.)

In old age and in adults with stiff and ossified cartilages, the lower end of the sternum advances, and the ribs move outwards; the outward movement of the eighth ribs being somewhat restrained during a deep inspiration. In some the lower end of the sternum falls back slightly, and then advances during an inspiration. (pp. 411, 419.)

As both the superior thoracic and the diaphragmatic muscular efforts are always, and the movements usually, exaggerated, the head is lowered at each inspiration, indicating excess of costal motion, while the larynx descends considerably, indicating excess of diaphragmatic action. (p. 412.)

The movement of the ribs and diaphragm during a deep inspiration is restrained. The smaller the breathing-capacity of the lungs, the less the increase of motion on a deep inspiration. (p. 417.)

Those parts of the chest that fall back during *ordinary* inspiration, only fall back at the beginning of a *deep* inspiration, after which, as the inspiration proceeds, they advance in proportion to its depth. (p. 418.)

The expiratory movements are the reverse of the inspiratory: in some, when the ribs fall back slightly during inspiration, they advance considerably during expiration; and in others, where the ribs do not advance during inspiration, but only stand still at the beginning of it, they move forward at the beginning of expiration and then fall backwards. (p. 412.)

The extent of the reversed inspiratory movement over the lower end of the sternum and the intermediate set of ribs is in proportion to the extent of the obstruction and the mobility of the chest. (p. 408.)

The rhythm of respiration is materially and characteristically affected in emphysema and bronchitis. The inspiration is short, the expiration is prolonged. During inspiration the air enters rapidly during the whole act, but the facility for inspiration increases towards the end. During expiration the air rushes out easily and quickly at first, but with increasing slowness and difficulty towards the end. During inspiration the air-tubes become larger towards the end, therefore inspiration is then easier; during expiration the air-tubes become smaller towards the end and more clogged with fluid, and therefore expiration is then more prolonged and difficult. (p. 418.)

The expiration is more prolonged in proportion to the obstruction in the smaller air-tubes; it is longer in emphysema when combined with bronchitis, than in either emphysema or bronchitis simply. It is more prolonged when the obstruction is in the smaller, than when it is in the larger, bronchial tubes. (pp. 414, 415.)

During inspiration the abdomen advances very rapidly; the upper part of the sternum and thoracic ribs stand still just at first, and then advance rapidly; the lower end of the sternum and the adjoining cartilages fall back usually during the whole act, sometimes only at the beginning of it, unless there be malformation of the chest or stiffness of the cartilages. (p. 415.)

During expiration the abdomen recedes very rapidly at first, then stands still, and again falls back interruptedly, and with increasing slowness; the upper part of the chest stands still just at first, then falls back rapidly, and becomes progressively slower towards the end of the act; the lower end of the sternum advances during the whole time, or it advances at first and then falls back. (p. 416.)

The increasing slowness towards the end of expiration distinguishes obstruction of the smaller bronchi from obstruction in the larynx, in which latter case it is also prolonged, but is equally slow throughout. (p. 414, 401.)

SECT. III.—*Effect of Diseases confined to one Lung or one side of the Chest, on the Movements of Respiration.*

A.—*Effect of pleuritis on the respiratory movements.*—I have not observed with the chest-measurer any case of pleuritis affecting the whole lung. In the two following cases the pleuritis was partial.

| | Sternum. | | Second rib. | | Sixth cartilage. | | Sixth rib. | | Eighth rib. | | Tenth rib. | | Abdomen. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | up. | lower. | right. | left. | right. | left. | right | left. | right | left | right | left. | right | cent. | left. |
| | in. | in. | in. | in. | in. | in. | in. | in. | in | in. | in. | in. | in. | in. | in. |
| Simpkin, (Table III.,) Case 133. | ·10 | ·11 | ·11 | ·08 | ·07 | *·07 | ·03 | *·005 | ·08 | ·10 | ·13 | ·10 | ·17 | ·10 | ·13 |
| Shepherd, (Table III.,) Case 134. | | | | | | | | | | | | | | | |
| First observation. | ·05 | *·03 | ·10 | ·10 | *·03 to *·04 | *·03 | ·03 | ·03 | ·08 | ·08 | ·08 | ·08 | ·06 | ·15 | ·06 |
| Second observation. | ·03 | *·02 †·02 | ·10 to ·20 | ·10 to ·20 | *·01 †·03 | *·02 | ·01 | *·01 | ·05 | ·03 | ·05 | ·04 | ·05 | 08 | ·07 |

The ordinary figures, and those with † prefixed, denote a forward movement; those with * prefixed, a backward movement of the costal walls during inspiration.

Sarah Simpkin, a woman of 40, had a rustling friction-sound over the anterior and lateral portion of the lower lobe of the left lung and the adjoining portion of the diaphragm. When she attempted to breathe deeply, her breath was caught by a severe pain over the cardiac region. In her the respiratory movements were everywhere normal, excepting just over the seat of the friction-sound, the left sixth costal cartilages moving ·07 in. and the right ·07 in.; the left eighth rib moving outwards ·1 in. and the right ·08 in.; but the left sixth rib fell in ·005 in., while the right sixth moved outwards ·03. In Simpkin's case the pleuritis locally restrained the breathing movement, at the seat of the pleuritis,—the sixth rib, and not at the seat of the catching pain,—the sixth costal cartilage.

Shepherd, a little girl of 7, suffering much from dyspnœa, presented comparative dulness on percussion over the lower lobe of the right lung, and over the upper lobe of the left. The inspiratory breath-sound was diminished, and the expiratory increased, over the lower lobe of the right lung; in the

opposite lobe the inspiration was coarse, the expiration unchanged; next day there was a loud smooth to and fro friction-sound. The expiratory-sound, whispering, as it were, under the ear, was audible when she whispered; and, when she spoke, œgophony was caused by the whispering expiratory friction-sound, accompanying and following the vocal resonance. In this girl, unequivocally suffering from pleuritis, the respiratory costal movements on the first day were perfectly normal. The sixth, eighth and tenth ribs of each side respectively ·03 in., ·08 in., ·08 in.; the right side of the abdomen presented a slight diminution.

Next day, when the dyspnœa was much lessened, the friction-sound being audible over the right lower lobe, the expansion of that lobe was somewhat greater than that of the left.

During the first examination, when the rapidity of breathing was excessive, and the costal and diaphragmatic breathing were both exaggerated, the lower end of the sternum and the sixth cartilage fell back ·03 in., owing to the rapid expansion of lung above and elongation of it below, causing intermediate collapse from atmospheric pressure, as was observed in emphysema and obstructed larynx. (pp. 404, 394.)

These two cases show that pleuritis without effusion may either cause diminished motion or not.

As a general principle, pleuritis undoubtedly does lessen the movements. Andral (Clinique Medicale, ii. 598) says, "Dans la pleurésie costo-pulmonaire la respiration est surtout diaphragmatique; au contraire, dans l'inflammation de la plèvre qui tapisse le diaphragme, ce muscle devient immobile, et la dilatation du thorax est surtout le résultat du mouvement d'ascension des côtes." Dr. C. J. B. Williams (Library of Medicine, iii. 110) considers the sign equivocal, and due to pain. Dr. Walshe (Diseases of the Chest, p. 219) states, that after pain has abated, the motions have acquired greater freedom until they were again obstructed by the accumulating fluid. M. Collin (Dr. Forbes' translation, in his "Original Cases," p. 294) says, that in the earliest stage the motions of the affected side are enfeebled or almost extinguished, the ribs

over the diseased part being fixed and the remainder moveable.

M. Collin's view is certainly too decided: indeed, non-motion in pleuritis would have a very injurious result; the fibrous adhesions, so usually met with, would be short, and confine the lung if there were no motion; as it is, they are long, and admit great freedom of movement; and this elongation of them is due to the to and fro movement of the lungs and ribs during respiration, drawing upon and lengthening the new and plastic adhesions.

The existence of friction-sound is itself a proof of respiratory motion in simple pleuritis, and Dr. Stokes justly attributes the frequent silence of pneumonic pleuritis to the want of pulmonic motion.

*Summary.*—Pleuritis, it may be justly said, usually restrains the respiratory movements sometimes because of pain, but sometimes although there be no pain. In some cases the movements are not at all lessened, and I believe, in simple or dry pleuritis, they are seldom, if ever, entirely destroyed. The respiratory movements of the opposite lung and of the unaffected portions of the same lung, are, from compensation, exaggerated.

B.—*Effect of effusions into the cavity of the pleura on the respiratory movements.*—This is one of the two cases allowed by Laennec to influence the breathing movements:—"Je n'ai jamais pu constater d'inégalité manifeste et constante dans les movemens des deux côtés du thorax, que dans des cas d'empyème très abondant ou de déformation de la poitrine." (De l'Auscultation Mediate, i. 24.)

Avenbrugger noticed deficient respiratory movement from pleuritic effusion nearly a century ago; M. Collin, Dr. Hodgkin, Dr. Williams, Dr. Walshe, Dr. Hughes, and others, have given to the sign its value; Dr. Stokes and Dr. Townshend, in their admirable descriptions of the disease in question, do not dwell on the symptom.

No disease has been more thoroughly illustrated than this,

as to the effect of the collection, in increasing the size of the affected side, on the position of the ribs and the intercostal spaces, and the displacement of the heart, the opposite lung, and the abdominal organs.

I have examined with the chest-measurer two cases of effusion into the right cavity of the pleura and three into the left.

| | Sternum. | | Second rib. | | Fourth rib. | | Sixth costal cartilage. | | Tenth rib. | | Abdomen. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upper. | lower. | right. | left. | right. | left. | right. | left. | right | left. | right | cent. | left. |
| LEFT CAVITY. | inch. | inch. | inch. | inch | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. |
| Walter Webb, æt. 16. | ·08 | *·01 †·04 | ·12 | ·05 | ·08 | 0 | ·06 | *·02 †·02 | ·10 | ·02 | ·10 | ·12 | ·06 |
| J. Roach. | ·12 | *·02 † 04 | ·05 | 0 | ·12 | 0 | ·08 | *·03 †·02 | ·12 | ·02 to ·03 | | | |
| Deep inspiration. | ... | ... | ·20 | ·12 | | | | | | | | | |
| T. Cook. æt. 6. | ·02 | ·03 | ·08 to ·12 | 0 | ·05 to ·08 | *·01 | *·01 †·04 | 0 | ·05 | ·01 | ·06 | ·15 | ·03 |
| Second observation. | *·02 | * 04 | ·08 to ·12 | 0 | ·08 | 0 | ·08 | * 02 | ·08 | 0 | ·12 | ·22 | ·03 |
| RIGHT CAVITY. | | | | | | | | | | | | | |
| Lydia Davis, æt. 18. | ·10 | *·04 | ·18 | ·17 | *·01 †·02 | *·01 †·01 | *·01 | *·02 †·02 | ·06 | ·12 | ·12 | *·03 | ·06 |
| James Brown, æt. 21. | ·03 | ·04 | ·05 | ·10 | ·02 | ·03 | ·03 | ·04 | ·05 | ·10 | ·10 | ·30 | ·16 |
| Deep inspiration. | ... | ... | ... | ... | ·40 | ·70 | | | | | | | |
| Health. | ·03 to ·06 | ·02 to ·06 | ·03 to ·07 | ·03 to ·07 | | | ·02 to ·06 | ·02 to ·05 | ·10 | ·10 | ·09 | ·25 to ·30 | ·09 |

The ordinary figures, and those with † prefixed, denote a forward movement; those with * prefixed, a backward movement of the costal walls.

In the cases of Webb (Table III., Case 137), Roach (Table III., Case 138), (for whose case I am indebted to Dr. Walshe,) and Davis (Table III., Case 136), the effusion was considerable. In Webb, the left, in Davis, the right, side was much distended. The heart was, in Webb, displaced, and its impulse felt to the right of the sternum, while the impulse of the apex in Davis was felt considerably to the left of the nipple. In Webb, the diameter over the nipples was, on the left side, 7·4 in.; on the right, 6·5 in.—nearly an inch of difference.

The effusion was not considerable in Cook. The left side was, however, an inch larger than the right. The heart beat to the right of the xyphoid cartilage. The effusion was dis-

appearing from Brown (Table III., Case 135), (Dr. Bence Jones favoured me with the examination of Brown and Webb,) the heart having returned to its normal position, and the tape measurements of the two sides being about equal. The diameter over the nipples was, on the right side, 7·8 in.; and, on the left side, 7·4 in.—not quite half an inch of difference.

In all the cases, the motion of the affected side was diminished, while that of the healthy side was exaggerated; the diminution extending, in W. Webb and T. Cook, to all the respiratory movements. In all the cases excepting Cook and Davis, the movements of the superior thoracic ribs—the second—were less affected than those of the intermediate and diaphragmatic ribs. This corresponds exactly to the principal seat of the effusion and consequent obstruction to respiration,—namely, the lower part of the chest.

The abdominal movements in Webb were restrained on the affected side and at the centre, but not on the other side. In Brown and Cook, the recovering cases, the abdominal movement was slightly exaggerated on the unaffected side, and normal at the centre and on the affected side. In Davis, the abdominal movements were, it is stated, reversed. My notes state that the motion was greater on the most affected side. Davis's case, which was obligingly shown to me by Dr. Ormerod, was complicated. The effusion into the right pleural cavity followed pneumonia, which still existed, of the lower lobe of the right lung, and there were indications of disease in the lower lobe of the left lung. As the abdominal movements are stated to be the reverse of what they are in the other cases—namely, greatly increased on the side of effusion—one is inclined to suspect an error in the note; otherwise, the complication must have modified the movements. The movements, both of the diaphragm and of the affected side, being diminished, the respiration by the thoracic ribs is exaggerated.

As the lung, when free from adhesions, is floated forwards at the upper part of the chest, and comes there, if anywhere, in contact with the ribs, so it is there that the respiratory

movements are modified to the least extent. Thus, in Davis Brown, Webb, and Roach—

| | Davis. | Brown. | Webb. | Roach. | | | Roach. |
|---|---|---|---|---|---|---|---|
| The second rib on the affected side moved during an ordinary inspiration . . | inch. ·18 | inch. ·05 | inch. ·05 | inch. 0 | and, on a deep inspiration, | | inch. ·12 |
| Second rib on unaffected side . . . | ·17 | ·10 | ·12 | ·05 | ,, | ,, | ·20 |

In Davis, the unusual exaggeration of the motion over the upper lobes, both sound and affected, was evidently due to the existing pneumonia, more than to the effusion. In Webb and Roach, the lower end of the sternum, and the sixth costal cartilages of the affected side, receded at the beginning of inspiration, and, towards the end of it, advanced. This partially-reversed motion is evidently due to the displacement, downwards, by the diaphragm, of a portion of the fluid, the chamber holding it being elongated below by the diaphragm, and widened above by the thoracic ribs. The lower part of the chest during inspiration at first collapses over the fluid, from atmospheric pressure. After a time, the increasing amount of air in the lung more than replaces the displaced quantity of fluid, and the walls of the chest again move forward. In Davis, the lower end of the sternum fell back throughout the inspiration, and the fourth and sixth cartilages of both sides receded either partially or entirely. In her, the expansion of both lungs, but especially the right, was impeded by the accompanying pneumonia, and hence I conceive the non-motion of the lower end of the sternum, and of the right sixth costal cartilage, towards the end of the act. (For an explanation of the falling back of certain parts of the chest in disease, see pp. 394, 404.)

In James Brown, the case in which the effusion had diminished, the lower end of the sternum and the sixth costal cartilage advanced during the whole inspiration. In him, the respiratory movement was throughout more nearly normal. The diminution, however, of the movements on the affected side were marked and universal.

| | Second rib. | Fourth rib. | Sixth cartilage. | Tenth rib. | Abdomen. |
|---|---|---|---|---|---|
| The ordinary inspiratory movements of the right, | inch. | inch. | inch. | inch. | inch. |
| the affected, side being | ·05 | ·02 | ·03 | ·05 | ·10 |
| Deep inspiration . . | — | ·40 | — | — | — |
| Of the left side . . | ·10 | ·03 | ·04 | ·10 | ·16 |
| Deep inspiration . . | — | ·70 | — | — | — |

In a case of extensive effusion, in which paracentesis was performed, I observed that the lower ribs fell in partially on the affected side, while they moved outwards on the healthy side.

I have had no opportunity of observing the diaphragmatic action in those cases where, from the extent of the effusion, the diaphragm is so displaced as to become concave instead of convex.

*Deep inspiration.*—In the worst cases, the extreme voluntary inspirations were not—indeed, could not be—observed. In Roach, they were very much restrained, the increase being from 0 in. and ·05 in. to ·12 in. and ·2 in. In Brown, the restraint was slight on the healthy side, and considerable on the affected side, the increase being from ·02 in. and ·03 in. to ·4 in. and ·7 in.

*Summary.*—When fluid is extensively effused into either cavity of the pleura, the affected side is throughout enlarged; the lungs are compressed, and float forwards and upwards, so as to be in contact with the superior ribs; the surrounding organs—namely, the heart, the opposite lung, and the abdominal organs—are all encroached upon and displaced. The motion of the whole affected side, both costal and diaphragmatic, is restrained, while the motion of the whole opposite side, excepting perhaps the diaphragm, is exaggerated. The exaggeration is more marked over the superior thoracic ribs, and the motion of those ribs is less diminished on the affected side, than over the lower ribs.

Owing to the displacement, downwards, of a portion of the fluid, the lower end of the sternum and the adjoining cartilages on the affected side fall back during inspiration, from atmospheric pressure. In extreme cases, the lower ribs fall in at the side during inspiration.

*Pneumothorax* excites nearly the same displacement in the walls of the affected side, and in the adjoining viscera, that effusion of fluid does, the difference being that, while in the latter the lungs are floated forward, in the former they lie upon the dorsum.

I have not observed any case of pneumothorax with the chest-measurer, but I have minute notes of the motion of the chest in the interesting case of Murden—an old man of 70, over whose chest the wheel of a waggon had passed. No rib was broken, but the left lung was ruptured at the lower anterior angle of the superior lobe: the lungs were affected with Laennec's emphysema. The left side was an inch wider than the right, "the respirations irregular, forty-two in the minute, chiefly abdominal; though all the thoracic muscles are employed, the right side of the chest expands considerably, whereas the left side, an inch wider than the right, does not expand." On the next day it is noticed that "the abdominal muscles contract suddenly and with rigidity at the commencement of expiration, the expiration sometimes commencing with a vocal noise."

I was summoned one day suddenly to a poor woman, dying, the nurse said, in one of the wards. She had phthisis, with cavities chiefly affecting the right side, the left side, as Mr. Martyn observed, having the greatest range of motion.—"On the right side the upper lobe is consolidated, and contains a large vomica, with gurgling heard over the whole lobe and cavernous respiration." When I saw her the respiratory movement of the left side, which was very prominent, was absent, while that of the right side was considerable. She was moribund, and I made no further examination. On post-mortem inspection, pneumothorax in the left cavity was discovered, the air coming from a ruptured abscess seated in the lower margin of the upper lobe. This case, though only partially observed, is interesting, in that first one side, then the opposite, had the greatest amount of motion, just as one or the other had the greatest amount of disease to restrain the motion.

C.—*Effect of condensation of the lung on the movements of respiration.*—Condensation of the lung follows the absorption of pleuritic effusion, when the lung does not recover its expansion, and is owing usually to firm semi-cartilaginous adhesions. The contracted side is in all its dimensions smaller than the sound side; the anterior inner margin of the sound lung encroaches on the contracted side, passing over to that side of the edge of the sternum; the sternum is drawn and the spine curved to the affected side. The diaphragm is high, and the abdominal organs consequently encroach on the chest. The heart, if the left side be contracted, is unusually to the left; if the right side, often greatly to the right, of the sternum; the whole lung, on the affected side, is contracted, the surrounding organs encroaching on that side,—in fact, there is the exact reverse of what the same case presented at the stage of extensive effusion, when the affected side was enlarged, and the fluid, which had condensed the lung, encroached on the surrounding organs, displacing the opposite lung, the heart, and the contiguous abdominal viscera.

In these cases the sound lung is enlarged and its respiration exaggerated.

The case of the boy Cook, already mentioned among those affected with effusion into the pleura, became, after some months, an interesting example of the effect of condensation of the lung on the respiratory movements. (p. 429.)

CASES OF CONDENSATION OF ONE LUNG FROM EFFUSION INTO THE PLEURA.

| | Sternum. | | Second rib. | | Fourth rib. | | Sixth costal cartilage. | | Sixth rib. | | Tenth rib. | | Abdomen. | | | Tape measurements. above nipple. | | Tape measurements. lower end of sternum | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upper. | lower. | right. | left. | right. | left. | right. | left. | right. | left. | right. | left. | right | cent. | left. | right. | left. | right. | left. |
| | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. |
| T. Cook, first observation, effusion into the pleura | ·02 | ·03 | ·08 to ·12 | ·0 | ·05 to ·08 | ·01 | *·01 †·04 | ·0 | ... | ... | ·05 | ·01 | ·06 | ·15 | ·03 | | | 10·7 | 11·2 |
| Ditto, second observation | *·02 | *·04 | ·08 to ·12 | ·0 | ·08 to ·12 | ·0 | ·08 | *·02 | ... | ... | ·08 | ·0 | ·12 | ·22 | ·03 | | | | |
| Expiration | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 11·5 | 11·1 |
| Third observation, condensation of lung | ·02 | *·03 | ·10 | ·0 | ·05 | *·01 | *·02 †·02 | *·03 | ·02 to ·05 | *·01 to *·03 | ·06 | ·01 | ·15 | ·20 | ·07 | ... | ... | 12·3 | 11·2 |
| Deep inspiration | ·45 | ·20 | ·60 | ·20 | ·30 | ·12 | ·40 | ·30 | ·40 | ·13 | ·20 | ·05 | ... | ·30 | ... | ... | ... | 12·7 | 11·3 |
| Antero-posterior diameter at the level of the junction, the fourth rib with its cartilage | ... | ... | ... | ... | 7·3 | 6·2 | | | | | | | | | | | | | |
| Barbara Beasley, æt. 7, fluid almost gone from left pleural cavity | ·0 | ·12? | ·10 | *·02 †·02 | ·05 | ·0 | ·07 | ·0 | ... | ... | ·05 | ·0 | ·08 | ·15 | ·0 | 10·7 | 9·5 | | |

The ordinary figures, and those with † prefixed, denote a forward movement; those with * prefixed, a backward movement of the costal walls during ordinary inspiration.

When the first observations were made upon Cook, (Table, p. 435, and Table III., Case 139,) the left side, on which was the effusion, was by half an inch larger than the right; the amount of effusion not being great; and the heart was displaced so as to beat to the right of the xyphoid cartilage.

At the time of the second observation, the dimensions of the sides were reversed, the right side being nearly an inch larger than the left, and the diameter of it above an inch greater. The right lung had expanded considerably, that side being an inch and a half larger than on the former occasion, while the left side was less. There was indeed some little respiration returning in the left lung, manifested by some resonance on percussion below the left clavicle. The heart's impulse was now unusually to the left of the nipple. It will be observed that the difference of motion was throughout very nearly the same during the first observation, when fluid was effused and doubtless being absorbed, and in the second, when the fluid had been absorbed and the lung was condensed.

During tranquil inspiration the whole condensed side was motionless, the abdominal movement was less by one half on the condensed than on the sound side, and the lower end of the sternum and the sixth left costal cartilage receded, owing to collapse of the elongated lung. (See p. 429.)

During a deep inspiration every part of the chest expanded, but the forward movement of the left side was only a third of that of the right side. The sixth, eighth and tenth ribs of the affected side moved outwards less in proportion than the superior ribs moved forwards; indeed, the dilatation from the thoracic ribs was markedly greater than that from the diaphragmatic, owing to the lung being more condensed below, and also to its being more elongated by the descent of the diaphragm. The expansion of the left thoracic ribs acts also to expand the left margin of the right lung, which moves during a deep inspiration about half an inch further to the left of the sternum.

The case of Beasley (Table III., Case 140,) resembles that of Cook in the recent, scarcely complete disappearance of

pleuritic effusion, and in the diminution of measurement; that of the condensed or left lung being 1·2 in. less than that of the right. In Beasley the whole movements of the left side, both costal and diaphragmatic, were annihilated, the left second rib alone moving, and the motion of that rib was exactly balanced, as it first retracted and then advanced ·02 in. The lower end of the sternum advanced in Beasley, whose case differs from that of Shaw in this circumstance, and in the annihilation of the diaphragmatic movement.

The influence of the diaphragmatic descent in Smith caused, as has been seen, elongation and collapse of the lung and consequent falling in of the lower ribs; in Beasley, as the diaphragm did not act, the lung was not elongated, did not collapse, and did not fall in excepting at the second ribs. During a deep inspiration, the sixth rib fell in ·05 in., the diaphragm then most probably descended, elongating the lung, and causing it to collapse. In cases such as this of Smith, when the expansion of one side of the chest is exaggerated, of the other diminished, the sternum moves a little towards the exaggerated or healthy side. This was pointed out to me by my pupil, Mr. Martyn; it is a circumstance that readily catches the eye, and is therefore of value in leading the attention to the cause of it.

*Summary.*—When the whole of one lung is simply condensed, the movements of that side are either much diminished, annihilated or reversed, while those of the opposite side are increased. The motion of the diaphragm on the affected side, though restrained, is not annihilated, the unexpandable lung being lengthened by the diaphragmatic descent, and the diaphragmatic and intermediate ribs consequently often fall in during inspiration, while the superior ribs are motionless, or move outwards but a little. During a deep inspiration the retraction and rest of tranquil breathing give place on the affected side to inspiratory expansion, greater from the motion of the thoracic ribs, and of the diaphragm, than from that of either the diaphragmatic or intermediate ribs.

The cases of consolidation complicated with phthisis will be considered under that subject.

D.—*Effect of phthisis on the movements of respiration.*—The lungs in phthisis present so infinite a variety of conditions, that we must look for a considerable variety in the phenomena presented by the movements of respiration. It so happens that though I have observed a fair number of cases with the chest-measurer in the advanced stages of phthisis, I have not examined any with it in the early stages.

*The whole of one lung affected.*—Among the advanced cases, there are thirteen in which the whole of the most diseased lung presented unequivocal marks of disease. The wood-cuts at pages 440 and 441, taken from J. Boot, having tuberculous disease of the whole right lung, represent the position of the ribs and lungs and other viscera, before and after the inflation of the lungs. They show the great diminution in the expansibility of the diseased side. In this case very firm tendinous adhesions enveloped the lower lobes, and combined with tuberculous deposit to prevent their free expansion.

In Neale, (Table, p. 439, and Table III., Case 141,) a communication existed between an abscess in the axilla and a dilated bronchial tube and small tuberculous cavities in the upper lobe of the left lung, through a carious opening in the second rib. The lower lobe contained many tubercles, but was chiefly solidified by the pressure of strong tendinous pleuritic adhesions. In Boot, (Table, p. 439, and Table III., Case 150,) there were cavities in the upper lobes of both lungs, but that of the right lung was chiefly affected, and the tendinous thickened costal pleura restrained the expansion of, and solidified, the lower lobe.

Those cases of phthisis affecting the whole of one lung are so nearly allied in the physical condition of the diseased part, and in the phenomena of respiratory motion, to the cases of condensed lung from pleural adhesions just considered, that it will be well to examine such cases before those where only the upper portion of the lung is diseased.

CASES OF PHTHISIS IN WHICH THE WHOLE LUNG IS AFFECTED.

| LEFT LUNG. | Sternum. | | Second rib. | | Fourth costal cartilage. | | Sixth costal cartilage. | | Sixth rib. | | Tenth rib. | | Abdomen. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upper. | lower. | right. | left. | right. | left. | right. | le ft. | right. | left. | right. | left. | right. | centre. | left. |
| W. Neale, age 51, tubercles in both lobes, especially the upper: consolidation of lower lobe | inch. *·03 | inch. *·04 | inch. ·11 | inch *·02 | inch. ·06 | inch. *·02 | inch. ·08 | inch. *·04 | inch. ... | inch. ... | inch. ·16 | inch. ·10 | inch. ·22 | inch. ·25 | inch. ·06 |
| Second observation ... | *·02 † 02 | *·04 | ·15 | *·01 †·03 | ·20 | *·03 | ·11 | *·03 | ... | ... | ·16 | ·08 | ·25 | ·15 to ·20 | ·14 |
| Daniel Hardy, age 41 ... ... | *·01 †·01 | ·11 | ·08 | ... | * 02 †·05 | *·03 †·04 | ·12 | *·01 †·02 | ... | ... | ·15 | ·09 | ·18 | ·15 | ·01 |
| Deep inspiration ... ... | ... | ... | ·15 | ·05 | ... | ... | ·40 | ·10 | ... | ... | ... | ... | ... | ·60 | |
| RIGHT LUNG. | | | | | | | | | | | | | | | |
| Joel Boot, age 39, in articulo mortis, p. 440, 441 | *·01 †·06 | *·10 | ·06 | ·10 | *·04 | *·03 | *·05 | *·05 | ... | ... | ·14 | ·15 | ·5 | ·25 | ·20 |
| Mary Robinson, age 15 ... | ·03 to ·06 | .05 to ·06 | ·02 to ·0½ | ·10 to ·12 | ·01 to ·03 | ·07 to ·12 | ·02 to ·03 | ·05 to ·06 | ·01 | ·10 | ·02 to ·04 | ·10 to ·15 | ·04 to ·07 | ·10 to ·15 | ·10 to ·15 |
| Deep inspiration ... ... | ·17 | ·10 | ·10 | ·50 | ... | ... | ... | ... | ·08 | ·30 | ·13 | ·40 | ... | ·50 | |
| Pearson, age 7, in articulo mortis, not quite exact | ·13 | ·10 | ·15 to ·20 | ·08 to ·10 | ·15 to ·20 | ·06 | ·15 | ·08 to ·10 | ·12 to ·16 | ·08 | ·20 to ·15 | ·15 | ·10 | *·06 | ·10 |
| Expiration ... ... ... | ... | ... | ·0 | ·02 †·12 | ... | ·02 *·08 | ... | ... | ... | ·02 †·10 | ... | ... | ... | ·10 *·04 | |

| | Above nipple. | | Xyphoid cartilage. | | Diameter at nipple. | |
|---|---|---|---|---|---|---|
| | right. | left. | right. | left. | right. | left. |
| Tape measurement in Mary Robinson ... | 11·4 | 11·8 | 11·1 | 12·1 | 5 | 6·1 |
| Ditto during deep inspiration ... | 11·6 | 12·5 | 11·2 | 12·4 | | |

The ordinary figures, and those with † prefixed, denote a forward movement; those with * prefixed, a backward movement of the costal walls during ordinary inspiration.

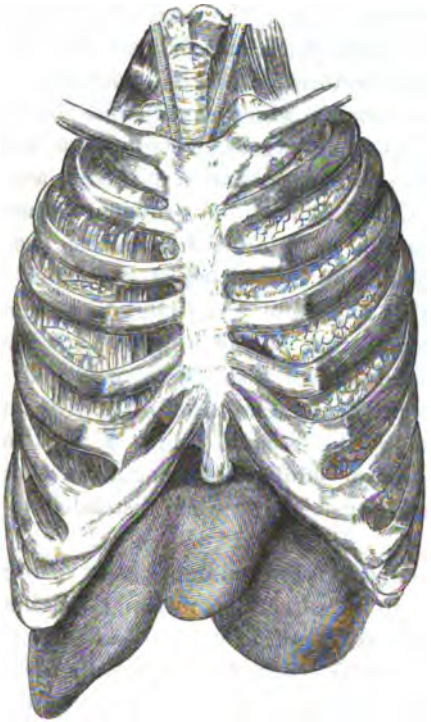
JOEL BOOT, AGE 39.

In this figure the lungs are not inflated; it represents *tranquil respiration*.

Tubercles and a cavity in the upper lobe of the right lung; tubercles through the right lower lobe; and universally thickened tendinous pleura, prevent the expansion of the whole right lung.

A small cavity on the summit of the left lung: this does not prevent the expansion of that lung, which is free and universal. See pp. 438-443, and Table III., Case 150.

There is, in such cases, general lessening of the most affected and general enlargement of the least affected side; the least affected lung descends considerably, and, in most cases, finds its way beyond the margin of the sternum over to the affected side.



JOEL BOOT, AGE 39.

In this figure the lungs are fully inflated: it represents a *deep inspiration.*

In the cases of Neale, (Table III., Case 141,) and Boot, (Table III., Case 150,), the expansion of the lower lobe was restrained, not by the tuberculous deposit so much as by the firm, strong adhesions. Those adhesions formed continuous bands of strong, thick tendons, passing from rib to rib, and enveloping the whole surface of the lung in contact with the costal pleura: they were truly intercostal adhesions. M. Louis (Dr. Walshe's translation, p. 35) found that out of 112 subjects who died of phthisis, one only was entirely free from adhesions; in twenty-five the adhesions were cellular, easily torn, limited; in the rest, they were either extensive or general, composed,

more or less, of cellular tissue; in these cases, large cavities were almost always found; the more advanced and extensive the disease, the more dense usually were the adhesions. Dr. Hodgkin, in his Lectures on Morbid Anatomy, vol. ii. p. 177, says: "The contraction which accompanies the changes which this pleuritic deposit undergoes, in conjunction with alterations in the lung, from the consolidation of texture and contraction of excavations, is, I believe, the principal means which produces the alteration of form which sometimes accompanies the want of resonance at some parts of the chest, in phthisical patients." This remark of Dr. Hodgkin, with regard to the permanent contraction of the lung in such cases, is, I am convinced, to be applied, also, as the principal cause of the deficient, absent, or reversed motion of those parts of the chest occupied by the diseased lung. I have found, that if adhesions be loose, cellular, and long, even though they be universal, the lungs enlarge when distended to the normal extent.

When the adhesions are tendinous, very strong, intercostal, passing from rib to rib, and embracing the lung in an unyielding tendinous sheath, as in the cases of Neale and Boot, then the lung can be distended but laterally very little, or not at all, although there is usually some descent of the diaphragm, and consequent elongation of the diseased lung, as is shown in the wood-cut, p. 441. In these cases, when the adhesions are cut across, the exposed tissue of the lung is usually in part expansible; but the adhesions prevent, or impede, the expansion.

In Pearson's case, the observations from whom were taken *in articulo*, the distention of the left lung, especially the upper lobe, was much restrained by intercostal adhesions, but not to the almost absolute extent found in Neale.

The impediment to expansion during life was, in these cases, proportioned to the strength and inexpansibility of the adhesions lining and restraining the ribs, and investing the lungs. It will be observed, that although all the movements were restrained, those of the thoracic and intermediate ribs

were so much more than those of the diaphragm and diaphragmatic ribs.

This will be found to apply to the thirteen cases in which there was, to a greater or less extent, consolidation of the lower lobe, and in all of which, except Neale, there were cavities of considerable size in the upper lobe.

The dimensions and respiratory movements of the opposite, or less diseased lung, were notably exaggerated. This exaggeration extended, in nearly all the cases, through the whole lung, the costal and diaphragmatic motion being alike increased.

The inspiratory elevation, and outward movement of the ribs, draws the sternum very palpably over to the unaffected side, a point to which my pupil, Mr. Martyn, drew my attention. In Neale's case, it was well seen that the sternum is drawn to the right by the right costal expansion; and in Boot's, to the left, by the expansion of the left side. (See wood-cuts at pp. 440, 441.)

When the right lung is affected, as in Boot, the exaggerated expansion of the left lung covers the heart during inspiration, and often causes the disappearance of its impulse, from the intercostal spaces, and its appearance below the xyphoid cartilage.

When the left lung is affected, as in Neale, owing to its deficient expansion, the heart is not further covered by it during inspiration, and its impulse, instead of being lessened in the intercostal spaces, is increased, as the heart is drawn downwards.

In Neale, the liver is pushed down extensively by the descent of the right side of the diaphragm, the stomach descending but little; while in Boot, the stomach is pushed extensively downwards, the liver descending but little. Out of thirteen cases, in which the lower lobe was more or less diseased, and in nine of which the left, and four the right, lung was affected, the sixth costal cartilages retracted during inspiration in ten, and the lower end of the sternum in six; in eight of the cases there was retraction of the sixth cartilage through the

whole inspiration; in the other two, only at the beginning. In one of the excepted cases—Elliott (Table III., Case 143,)—the lower end of the sternum fell back at the beginning of inspiration; and in the other—Pearson (Table III., Case 148,)—who was observed *in articulo mortis*, the abdomen retracted during inspiration at the centre, the costal action was consequently throughout exaggerated: in her, the ribs over the affected side protruded slightly, and the abdomen considerably, at the beginning of inspiration.

The retraction was, in these instances, as in those where it occurred from condensation, due to the rapid elongation and collapse of the lower portion of the lung, by the descent of the diaphragm. (p. 436).

In two of the cases, the upper end of the sternum fell back throughout, and in four, just at the beginning of, inspiration. This partial retraction of the upper end of the sternum might be due, in some of the cases, to obstruction to inspiration, from laryngitis. But we shall have to consider another cause, residing in the non-expansibility of the thickened walls of the cavity.

*Cavities in one upper lobe.*—I have observations of twenty-four cases in which there were cavities in one upper lobe; the upper lobe of the opposite lung was in all the cases notably less diseased, and the lower lobes of both lungs were not appreciably affected. All those cases in which the whole of one lung was diseased have been already taken out and placed in the previous subsection.

| | | |
|---|---|---|
| Of the 13 cases in which the whole of one lung was more or less solidified with cavities in the upper lobes . . . | in | 9, the left was affected.<br>4, the right ,, |
| Of the 24 cases in which there were cavities in the upper lobe only of one lung | in | 14, the left was affected.<br>10, the right ,, |

The accompanying lithographs from daguerreotypes of Samuel Redgate, (Table III., Case 163,) the once celebrated fast bowler, illustrate the change in the visible form of the chest, and the position of the viscera during a deep inspiration. In the daguerreotype taken during tranquil respiration,

PLATE VII

Fig. 2.

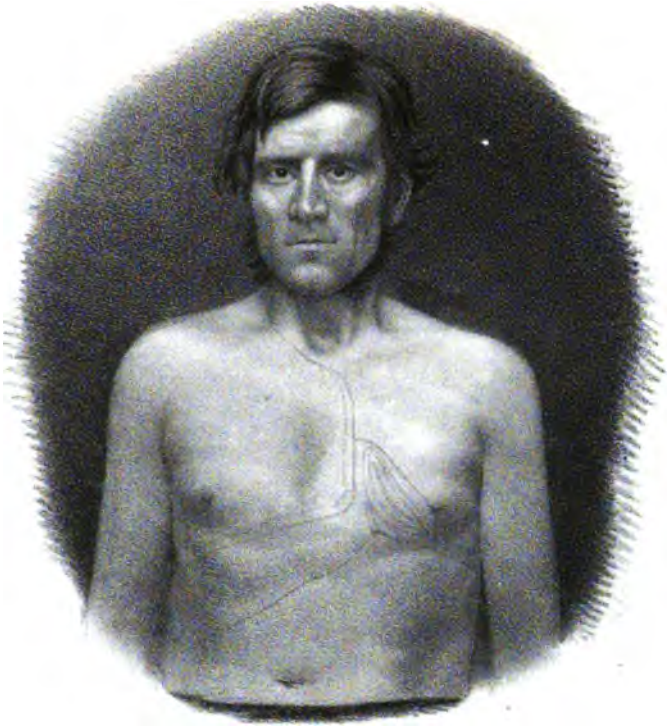
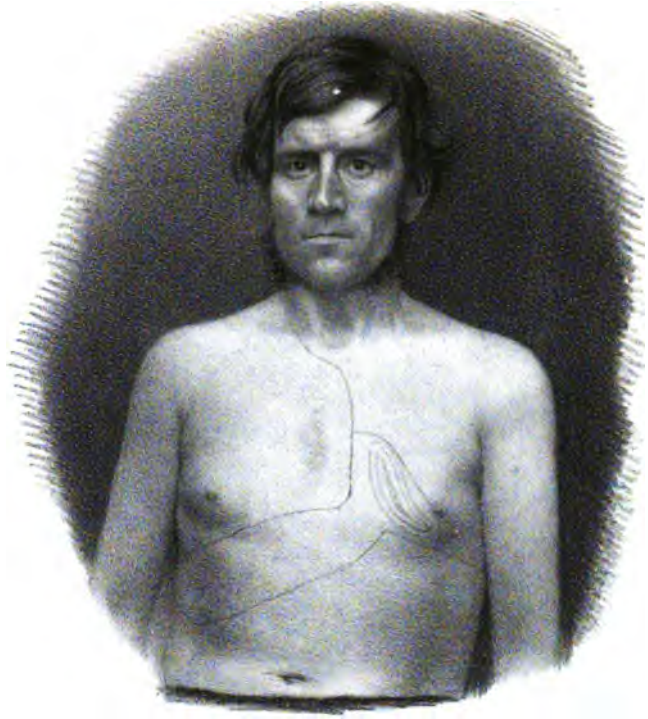


Fig. 1.



SAMUEL REDGATE . PHTHISIS.

Lithog.d from Daguerreotype by

B. George. 54 Hatton Garden.

the right side is manifestly larger than the left, but not very materially so; the right lung encroaches on the left side, its inner margin coming beyond the left edge of the sternum. Owing to the falling away of the diminished left lung, the heart is in extensive contact with the costal walls, and its impulse is felt from the third to the sixth costal cartilage.

In the daguerreotype taken during a deep inspiration the left shoulder is scarcely elevated, while the right is raised to a very great extent, and the whole right side is strikingly larger than the left side; the right lung encroaches still further on the left side: the lower margin of that lung descends more than the heart, the impulse of which is not lessened above by the expansion of the left lung, but becomes more extensive below owing to its own descent.

When the right upper lobe is consolidated, the exaggerated expansion of the left lung lowers and lessens the extent of the impulse in the intercostal spaces during an ordinary healthy inspiration; and causes its disappearance from the intercostal spaces, and appearance below the xyphoid cartilage, during a deep inspiration: on the contrary, if the left upper lobe be affected, as in Redgate, the left lung falls back from before the heart, exposing it extensively, so that the impulse is felt often from the second to the fifth or sixth costal cartilage; and during a deep inspiration the impulse increases in extent downwards, without being lessened above.

The following selected cases illustrate the movements of respiration when cavities are seated in the right or left upper lobe.

CASES OF PHTHISIS IN WHICH ONE UPPER LOBE IS AFFECTED.

| | Sternum. | | Second rib. | | Fourth costal cartilage. | | Sixth costal cartilage. | | Sixth rib. | | Tenth rib. | | Abdomen. | | | Tape measurements. above nipple. | | at xyphoid cartilage | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upper. | lower. | right. | left. | right. | left. | right. | left. | right. | left. | right. | left. | right. | centre. | left. | right | left. | right | left. |
| LEFT SIDE. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. |
| S. Redgate, 37, breathing capacity 150, large vomica, improving. (See Lithographs.) | *·01 †·02 | *·02 †·05 | ·06 to ·10 | ·03 to ·07 | ·13 | *·02 †·02 | ·08 | *02 †·04 | ·07 to ·09 | ·03 to ·05 | ·09 to ·11 | ·07 | ·14 | ·40 to ·50 | ·08 | 18·2 | 16·9 | 18·2 | 17·6 |
| Deep inspiration | *·02 †·20 | *·02 †·25 | ·50 | ·30 | ·55 | ·30 | ·34 | ·24 | ·50 | *·05 †·30 | ·30 | ·30 | ·24 | ·90 | ·18 | 18·9 | 17·3 | | |
| R. Stanyon, 36, breathing capacity 246, large vomica, getting worse | ·08 to ·10 | ·07 | ·08 to ·11 | ·06 to ·08 | ·06 | *·01 †·01 | ·09 | *·01 †·02 | ·07 | ·03 | ·15 | ·14 | ·13 to ·15 | ·35 | ·18 | 13·8 | 16·4 | 15·5 | 15·2 |
| M. Castle, large cavity | ·13 | ·06 | ·12 to ·16 | ·08 to ·13 | ·04 to ·05 | *·02 †·03 | ·05 to ·06 | ·03 to ·05 | ·06 | ·03 | ·15 to ·20 | ·10 to ·12 | ·08 to ·09 | ·15 | ·07 to ·08 | 13·8 | 12·2 | | |
| RIGHT SIDE. | | | | | | | | | | | | | | | | | | | |
| S. Fowles, 27 | ·08 | *·12 | ·05 to ·08 | ·12 to ·14 | *·03 | ·07 | *·05 | ·0 | ... | ... | ·16 | ·15 | ·15 | ·20 | ·16 | | | | |
| S. Daft, 65 | ·09 | *·02 †·08 | *·01 †·03 | ·09 | *·03 †·01 | ·05 | *·02 †·04 | ·08 | ... | ... | *·03 | ·10 | ... | ·30 | | | | | |
| Deep inspiration | ... | ·60 | ... | ... | ... | ... | ·40 | ·60 | ... | ... | ·30 | ·50 | | | | | | | |
| J. C. Searle, 25 | ·06 | ·05 | ·06 | ·12 | *·02 †·02 | ·06 | ·05 | ·06 | ... | ... | ·07 | ·08 | ... | ·17 | ... | 15·2 | 15 | 14·5 | 14 |
| Saywell ... | ·20 | *·02 | ·20 | ·20 | ·03 | ·02 | ·04 | ·03 | ... | ... | ·06 | ·09 | ·05 | ·09 | ·03 | | | | |
| Deep inspiration | ... | ... | ·80 | ·60 | | ... | | | | | | | | | | | | | |

The ordinary figures, and those with † prefixed, denote a forward motion; those with * prefixed, a backward motion of the costal walls during ordinary inspiration.

In only one of the twenty-four cases—Green (Table III., Case 154,)—was the most affected side largest. In Astell, (Table III., Case 155,) the two sides were equal; and in Stanyon, (Table III., Case 162,) nearly so. The increased size of the least diseased lung was not confined to the subclavicular space, but also extended over the whole front of the chest, down to the lower boundary of the heart and lungs, or to the sixth costal cartilages.

I need not say that although the cases are classed as being diseased in the right or left upper lobe, yet the opposite lung is likewise in almost all cases affected with tuberculous disease, though in a less advanced stage. Consequently, although I have observed no cases of incipient phthisis with the chest-measurer, yet in most of the cases the lung having cavities is compared with a lung in the earlier stages.

In twenty-three of the twenty-four cases, the respiratory movements were decidedly and considerably less on the most affected side. In the exception, Saywell, there was undoubtedly a cavity on the right side; yet the motion of that side was a shade greater than that of the opposite. In S. Hoffen my notes state that some of the movements were greater, some less, over the affected side; here I suspect an error.

In only two of the cases was there absolute non-motion over the cavity; these were the cases of Green and Astell, in the first of whom the affected side was the largest, while in the other the two sides were equal; in neither of them was costal respiration exaggerated. The cavity was superficial in Green, but it was not so in Astell; probably in the last case a block of solid tubercle was situated over the cavity: both of these cases had considerable mobility over the opposite second ribs, their extreme inspiratory movements being respectively ·85 in. and 1 in.

In none of the cases was the motion reversed over the cavity through the whole inspiration; though in three of them the rib receded ·01 in. to ·02 in. at the beginning of the inspiration, and then advanced.

If the eye run down the parallel columns of the movements of the second rib, just over the cavity, it will be seen that in nearly all, the motion of the most affected side was about one half of that of the less affected side. The motion of the opposite lung was considerably exaggerated in fifteen cases; moderately so in four; and not so in five. In the ten cases in which the costal breathing was not notably exaggerated, the abdominal was slightly so. Although the cavity has, over its centre, almost always an inspiratory movement, yet at its margins I have often found the motion abolished, and even reversed. The fourth costal cartilage is often over a consolidated portion of lung, which forms the walls of the cavity. The fourth costal cartilages receded either at the beginning or during the whole of an inspiration in fourteen out of twenty-two cases. The fourth cartilages receded in six out of ten cases on the right side, and in eight out of twelve on the left.

Of the whole thirty-nine cases observed in which there were cavities in one lung, there were eleven in which the upper end of the sternum fell in at the beginning of inspiration. This might be in some cases from laryngitis; but as the laryngitis of phthisis does not usually obstruct respiration materially, as is manifested in the case of Andrews, (Table III., Case 179,) I conceive this can seldom have an influence. The falling back of the upper end of the sternum is, I conceive, due to its being so often in front of the consolidated border of the cavity. The lung outside the consolidated portion expands, and the cavity itself expands also, when acted upon by the costal movement. I conceive that the expansion of the lung to each side of the consolidated wall of the cavity stretches that wall and causes it to collapse, hence it so often recedes just at the beginning of inspiration. In a few cases, especially over the fourth rib, the wall recedes during the whole inspiration. For an explanation of the cause of the falling back of the costal walls in disease, see pp. 394-399.

In many cases, both around and over the cavity, the thoracic wall stands still just at the beginning of an inspiration.

This is, as it were, the first stage of an absolute falling back. The same phenomenon is observed in emphysema.

The lower end of the sternum, and the adjoining sixth cartilage on the affected side, recede, either at the beginning of inspiration, or throughout, in about one half of the cases. Here the falling in is due to the elongation of the affected lung through the action of the diaphragm, and its consequent collapse.—See pp. 443, 444.

The elevation of the clavicle and sternum, in the few cases in which I observed it, corresponded with the forward movement of the sternum and second rib. In one half of the cases, the action of the diaphragm is somewhat restrained on the affected side. The movement of the diaphragmatic ribs was diminished

In 6 cases out of 10 on the right side when that side was affected.
And in only 4 „ 13 on the left side „

This preponderance of restraint on the right side is probably due to the presence of the liver, which is often enlarged in phthisis.

While examining the movements over a cavity, I have found, at short intervals, a great change in their amount. This could occasionally be traced to the accumulation of the contents of the cavity at intervals, and to the consequent additional obstruction to its expansion and contraction. The gurgling rhonchus is most usually heard at the beginning of an inspiration, and the end of an expiration; the cavity and its tubes are then smallest, and the fluid it contains most nearly fills it; at the end of inspiration and beginning of expiration, when the cavity is expanded to its full extent, the fluid gravitates to the bottom of the cavity, away from the bronchial inlet; but by and by, when the cavity is again lessened by expiration, the fluid again plugs its outlet, and re-produces the cavernous rhonchus.

The prolongation of the expiration, and its increasing slowness towards the end, is often due to the same cause.

*During a deep inspiration* the difference between the expansion of the two sides is usually very apparent to the eye. The cavernous lung usually expands from one half to two-

thirds of the amount that the opposite lung does; the proportional difference between the expansion of the cavernous and that of the opposite lung is somewhat lessened, but the actual difference, from the whole motion being increased, is much greater, and, therefore, much more palpable.

If there be disease in one lung, the restrained motion on that side will, as has just been said, be more palpable during a deep than during an ordinary inspiration; but if there be diminished motion during tranquil breathing, without any morbid cause, the difference in the motion will usually disappear during a deep inspiration; the movement, for instance, may be ·03 in. on the right side, and ·06 in. on the left, in tranquil breathing; and on taking a deep breath they may be 1·1 in. on the right, and 1 in. or 1·1 in. on the left. Here we possess an unequivocal sign of the absence of difference in the amount of disease on the two sides.

In many cases, the movements are very much restrained over the cavity during a deep inspiration; if they be so, the movements over the opposite lung are usually also restrained, and in a like proportion.

| | Over the Cavity inch. | Over the corresponding part of the opposite Lung. inch. | Abdomen. inch. |
|---|---|---|---|
| In Durow, the movement, on a deep inspiration | ·15 | ·35 | ·30 |
| Harly | ·05 | ·15 | |
| Rutland | ·16 | ·30 | |
| Porter | ·00 | ·30 | |
| Castle | ·20 | ·35 | ·40 |
| Smith | ·26 | ·35 | ·40 |
| Emmet | ·35 | ·60 | |
| Redgate | ·30 | ·50 | ·90 |
| Searle | ·40 | ·60 | |
| Kirk | ·40 | ·70 | 1·00 |
| Alvey | 40 | ·85 | |
| Do., second observation | ·55 | ·90 | ·70 |
| Green | ·45 | ·85 | ·70 |
| Astell | ·70 | 1·00 | |
| Parson | ·70 | 1·00 | 1·50 |
| Searle, second observation | ·80 | 1·20 | |

When the cavity is lessening, and the health improving, the restraint on the cavernous side may increase, while the movement on the opposite side may increase. Thus—

| | | | |
|---|---|---|---|
| In Robinson (a case of this class long watched) | ·10 | ·50 | ·50 |

The extreme advance of the abdomen is, also, usually restrained in proportion (within certain limits) to the restraint on the extreme movement over the cavity during a deep inspiration, as is evident in the above Table.

If the disease be improving, as in Redgate and Robinson, the abdominal motion is proportionally greater.

*Cavities, or softening tubercles, in the upper lobes of both lungs in nearly equal degree.*—In these cases, the movements of the two sides more nearly balance each other.

The two sides do not usually differ in contour; the whole chest is flat, the sternum being as prominent as, or more so than, the 3rd, 4th, or 5th costal cartilages; the lungs, falling away from the heart, leave it extensively exposed; the mass of the lungs, unless there be universal tuberculous deposit, is diminished; the size of the abdominal, in proportion to that of the thoracic, organs is, therefore, considerably increased, and the hepatic and gastric bulges are high and prominent.

I have examined, with the chest-measurer, four cases of this class.

CASES OF PHTHISIS IN WHICH THE UPPER LOBES OF BOTH LUNGS WERE AFFECTED.

| | Sternum. | | Second rib. | | Fourth rib. | | Sixth costal cartilage. | | Eighth rib. | | Tenth rib. | | Abdomen. | | | Tape measurements. above nipple. | | Tape measurements. at xyphoid cartilage. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upper. | lower. | right. | left. | right. | left. | right. | left. | right. | left. | right. | left. | right. | centre. | left. | right. | left. | right. | left. |
| | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. | inch. |
| T. Andrews, sides equal, numerous cavities in both lungs behind | ·10 | ·05 | ·15 to ·18 | ·09 to ·15 | ·06 | ·05 | ·05 | ·05 | ·12 | ·12 | ·10 | ·10 | ·14 | ·20 | ·20 | | | | |
| J. German, cavities on both sides, more on right | ·03 to ·10 | ·04 | ·06 to ·15 | ·10 to ·20 | ·05 | *·01 †·05 | ·03 | ·04 | ... | ... | ·11 | ·11 | ·12 | *·05 †·15 | ·05 | | | | |
| Second observation | ·06 | *·05 | ·08 to ·10 | ·13 | ·06 | ·06 | ·03 | ·03 | ... | ... | ·10 | ·10 | ·13 | ·20 | ·04 | | | | |
| D. Flanagan, aged 39, cavity in right lobe, deposit in left, sides equal. Diameter—right, 5·7; left, 5·9 inch. | ·02 to ·10 | *·01 †·02 | ·04 to ·08 | ·04 | ·03 | ·05 | ·02 | ·05 | ... | ... | ·05 | ·05 | ·05 | ·18 | ·08 | 17·2 | 17·2 | 17·2 | 17 |
| Deep inspiration | ... | ... | ·15 | ·20 | | | | | | | | | | | | | | | |
| S. Vallance, aged 15, cavities in both lobes, largest in the left; left side largest | *·02 | *·09 | * 01 †·03 | *·01 †·03 | *·02 †·02 | *·03 | ·03 | *·03 | ... | ... | ·11 | ·10 | ·16 | ·23 | ·16 | 13 | 13 | 12·5 | 11·6 |
| Deep inspiration | *·04 †·04 | ... | ·25 | ·35 | ·30 | *·04 †·04 | ·20 | ·12 | ... | ... | ·30 | ·20 | | | | | | | |

The ordinary figures, and those with † prefixed, denote a forward movement; those with * prefixed, a backward movement of the costal walls during ordinary inspiration.

These cases present slight differences here and there, in perfect keeping with the minor difference in disease on the two sides.

In Flanagan, a patient of Dr. Roupell, at St. Bartholomew's Hospital, (Table III., Case 180,) the difference is trifling on a deep inspiration, and does not exist during ordinary breathing; the solidified, or softened left lung, obstructs the movements nearly as much as the cavernous right lung.

*A cavity in the middle lobe of the right lung.*—I have examined one case of this kind.

In this case, a cavity existed in the middle lobe, and occasioned a very marked restraint in the motion of the 4th and 6th cartilages on that side; in fact, their motion was annihilated, as is shown in the annexed Table.

| | Sternum. | | Second rib. | | Fourth rib. | | Sixth rib. | | Tenth rib. | | Abdomen. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upper. | lower. | right. | left. | right. | left. | right | left. | righ | left. | right | cent. | left. |
| J. Tenuini, 40 | inch. ·05 to ·10 | inch. ·05 | inch. ·08 to ·10 | inch. ·10 to ·14 | inch. ·01 to ·02 | inch. ·02 | inch. ·0 | inch. ·12 | inch. ·10 | inch. ·12 | inch. ·12 | inch. ·20 | inch. ·10 |
| Deep inspiration | ·30 | ... | ... | ... | ... | ... | ... | ... | ·10 | ·30 | | | |

From these observations we may conclude, that wherever and whenever an extensive cavity exists in the lung, the respiratory movements are restrained over that cavity, but not obliterated; that the respiratory movement is greater over the centre than over the circumference of the cavity, and that, immediately over the circumference, the ribs or sternum often recede, either during the whole inspiration, or, which is more usual, only at the beginning of it. The firm, tendinous, pleuritic adhesions that surround the lungs in the advanced state of tuberculous disease have more restraining influence over the movements than the disease itself has.

*"Incipient" phthisis.*—I have no observations to offer made by the chest-measurer, in persons affected with phthisis at this stage. The united testimony of Andral, Sir James

Clarke, Dr. Forbes, Dr. C. J. B. Williams, M. Collin, M. Fournet, Dr. Hughes, and other accurate observers, affirms, that even in the early stages the movement of inspiration, especially on a deep inspiration, is restrained over the seat of the disease.

The observations of Andral speak directly to the point of the immobility, or partial mobility, of the chest, over that part where the lung is indurated from agglomeration of tubercles.* It follows from the physical nature of the progressive changes in phthisis, that the inspiratory motion over a cavity which has a respiration of its own, must be greater than that over the more solid but softening tuberculous mass that immediately precedes the formation of a cavity. On this point I hope to make further special inquiries.† Andral has, however, decided it as a matter of direct observation.

*Summary of the effects of phthisis on the movements of respiration.*—In the earlier stages, the movements over the diseased portion of lung are restrained. When a mass of

* "Dans la phthisie pulmonaire, l'on observe un phénomène encore plus remarquable; c'est l'immobilité, ou du moins la dilatation moindre d'une partie plus ou moins étendue d'un des côtés du thorax, là où les tubercules sont agglomérés en grand nombre. Cette immobilité plus ou moins complète d'une partie des parois thoraciques, est surtout évidente chez certains phthisiques, au-dessous de l'une des clavicules, entre cet os et le sein. Ce n'est pas avec l'existence de vastes excavations tuberculeuses que coincide le plus souvent ce défaut partiel des mouvemens des côtes, mais bien avec l'existence d'une pneumonie chronique formée, soit autour de tubercules crus et plus ou moins nombreuses, sois autour de petites cavernes. C'est à dire que l'immobilité partielle des côtes coincide le plus ordinairement avec un son mat."—*Andral, Clinique Medicale*, ii. 97.

† *Postscript, August* 1848.—Dr. Barlow recently favoured me with the observation of a patient of his, at Guy's Hospital, that illustrates this passage. There was a large cavity at the summit of the right lung, and a consolidated mass of tubercles and a smaller cavity at the summit of the left lung. The second, third and fourth ribs were more prominent on the left side than the right; and the respiratory motion, as indicated by the chest-measurer, was greater, both during an ordinary and a deep inspiration, over the extensive cavity on the right side than over the half-consolidated, half-cavernous, lung on the left side.

lung is solidified by tuberculous disease, the mobility is still further restrained. (p. 453-454.)

Where cavities are formed, their inspiratory expansion is much diminished, chiefly by the firm, tendinous, and pleuritic adhesions that embrace the diseased portion of lung. (p. 441-453.)

There is almost invariably some movement of inspiration over the cavity. But although the part in question always advances during inspiration, especially a deep inspiration, yet, at the beginning of the inspiration it sometimes recedes slightly, and frequently stands still just before its inspiratory advance. (p. 447-453.)

The respiratory expansion and movements over a cavity are greatest just towards the end of inspiration and the beginning of expiration, when the cavity and the tubes leading to it are the largest, and when the fluid in the cavity lies in its hollow, and does not plug the bronchial tubes. The obstruction to the movement over many cavities, especially those containing liquid, is greatest just at the beginning of inspiration, and towards the end of expiration, when the cavity and tubes are at the smallest, and the fluid, its amount being the same, plugs the bronchial tubes. The obstruction to cavernous respiration varies with the amount of fluid in the cavity and its tubes. (p. 449.)

The firm walls surrounding a cavity have no inspiratory expansion: the respiratory movements over the region of dulness surrounding a cavity are much smaller than those over the cavity itself; they are often immobile; their motion is often reversed at the beginning or through the whole course of inspiration and expiration. (p. 448.)

The reversed motion is most frequent over the third and fourth cartilages.

The motion of the lower end of the sternum, and the sixth cartilages, on the affected side, is often reversed by the diaphragmatic lengthening and collapse of the lung. (p. 449.)

The descent of the diaphragm is somewhat restrained on the affected side, in about one-half of the cases; the motion of the right diaphragmatic ribs is more frequently diminished than that of the left, when the respective superior lobes are diseased, owing, I believe, to the presence of the enlarged liver. (p. 449.)

When the whole lung is more or less consolidated, and its expansion obstructed by tendinous adhesions, the lateral expansion of the whole affected side of the chest is lessened. (p. 438-444.)

If the diaphragm act freely, the movements of the sixth costal cartilage on the affected side may be reversed. Those of the superior thoracic ribs, over the cavity, are never reversed throughout, seldom even at the beginning of inspiration and expiration, but those of the third, fourth and fifth cartilages are often prevented and reversed.

The respiratory movement of the opposite lung is, in the great majority of cases, exaggerated.

E.—*Effect of pneumonia on the movements of respiration.*—Laennec repeatedly assured himself that the dilatation of the chest was equable in cases of peripneumony, confined to one side.* Grisolle invariably found the dilatation equal, unless pleuritic pain of severe character existed. Dr. Walshe, remarking on these statements, is satisfied that the motions of the chest are diminished in simple pneumonia, with extensive consolidation, independently of the influence of pain. Dr. Stokes incidentally remarks, that the absence of frottement in pneumonia is owing to the diminished motion of the inflamed lung. Dr. C. J. B. Williams states that manual examination may often detect a deficiency in the motion of the ribs of the affected side. M. Fournet observes that, in chronic pneumonia of the upper lobe, diminution of motion is seen. From these statements, one is led, *à priori*, to expect that, in some cases of pneumonia, the movements on the affected side are diminished, and that in others they are

* Dr. Forbes' Translation, p. 13.

not. This is corroborated by the few observations I have yet made with the chest-measurer in pneumonia.

| | Sternum. | | Second rib. | | Fourth rib. | | Sixth rib. | | Tenth rib. | | Abdomen. | | | Tape measurements. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | upper | lower | right | left | right | left | right | left | right | left | right | centre | left | right | left |
| | inch | inch | inch | inch | inch | inch | inch | inch | inch | inch | inch | inch | inch | inch | inch |
| H. Kitchen, age 35, pneumonia, rapid recovery | ·03 | *·01 † 03 | ·05 | ·05 | ·03 | ·02 | ·04 | ·03 | ·08 | ·09 | ·08 | ·20 | ·18 | 17·7 | 16·4 |
| Deep inspiration | ·06 | *·02 †·04 | ·10 | ·08 | ·05 | ·06 | ·07 | ·05 | ·10 | ·07 | ·06 | ·18 | ·15 | | |
| T. Carrington, recovery not very rapid | -05 | ·03 | ·03 | ·03 | ·0 | ·03 | *·01 †·03 | ·04 | ·04 | *·01 | ... | ·28 to ·40 | | | |
| Second observation | *05to*·08 | *·07 | ·03 to ·05 | ·15 | *·02 | *·02 | *·05 | *·02 †·01 | ·09 | ·09 | ·12 | ·16 | ·08 | | |
| E. Streeton, 18, pneumonia of right lower robe, bronchitis | *·02 †·05 | *·10 | *·03 †·06 | ·12 | *·06 | ·04 | *·02 | ·08 | ·12 | ·19 | ·12 | ·25 | ·17 | | |

The ordinary figures, and those with † prefixed, denote a forward movement; those with * prefixed, a backward movement of the costal walls during ordinary inspiration.

In Kitchen, the respiration always went on freely. Crepitation in the right lower lobe soon gave place to a mucous rhonchus, and resonance on percussion returned. Viscid brown sputa were readily parted with. The pneumonic lung was, by an inch, the largest. The respiratory costal movements of the affected side were never less than those of the left side, and during a deep inspiration they were somewhat greater. The deep inspiration was remarkably restrained, on both sides, and over all parts of the lung. The movement, on a deep inspiration, was, over the right and left second rib, only ·10 in. and ·08 in. respectively, and a like proportion was kept throughout, so that the costal motion was not a tenth of its natural amount. This small range of respiration on both sides accounts, in part, for the equal expansion, but this is chiefly, I conceive, due to the expansibility of the diseased lung, the air-tubes being at all

times permeable. In fact, consolidation was never established.

Although the *costal* respiration was equal on the two sides, yet the action of the *diaphragm* was considerably less on the affected side, the abdominal movement being ·08 in. on the affected, and ·18 in. on the left side.

The cases of Carrington and Streeton were not purely pneumonia. In Streeton, who died, it was complicated with bronchitis; in Carrington, with the prevailing influenza. In both, pneumonia existed in the right lung, and the movements were restrained over that lung.

*Summary.*—I am not entitled to infer with confidence, from these scanty materials, what are the characteristic modifications of pneumonia on the respiratory movements.

From what many accurate observers have stated, from the cases here given, and other cases observed without the chest-measurer, and from the nature of the disease and its analogy to condensation of the lower lobe of one lung, one is, I conceive, entitled to say, that when the lower lobe, affected with pneumonia, is consolidated, the costal and diaphragmatic motion over the consolidated portion of lung is restrained.

Pneumonia of the lower lobe may sometimes cause restraint in the movement of the ribs over the corresponding upper lobe. In a case observed by me some years since, my attention was directed to pneumonia in the base of one lung, by the movement over its apex being deficient in comparison with that of the opposite lung.

I believe it will be found that, in all cases of pneumonia of the lower lobe of either lung, the descent of the diaphragm on the affected side is restrained, while that of the opposite side is exaggerated.*

* Dr. Barlow favoured me lately with the examination of a female affected with pneumonia of the lower lobe of the right lung. The movement of the diaphragmatic ribs (the ninth) over the affected side was ·1 in.; over the left side, ·3 in. The abdominal parietes, which had but little motion below the left tenth rib, actually fell in from ·06 in. to ·1 in. over the corresponding point of the right side. This case is an additional proof that non-

That, in those cases where the costal motion is restrained, the restraint will be greatest in the lower ribs—the diaphragmatic and intermediate sets (illustrated by Dr. Barlow's case).

That the expansion of the chest over the unaffected side is exaggerated in all cases, and, in some cases, that also of the thoracic walls over the unaffected lobe of the diseased lung.

In acute pneumonia, the restraint to the increased inspiratory movements, during an attempt at a deep inspiration, is great and universal.

F.—*The rhythm of respiration in those cases where the disease is confined to one lung, or one side of the chest.*—In all the diseases of this class, the rhythm of respiration may be affected. In none of these diseases is the rhythm always deranged. In all of them, when the rhythm is altered, the expiration is prolonged.

The prolongation of the expiration is always, I believe, due to obstruction in the bronchial tubes; and in all these cases the expiration is quick at the commencement of the act, and becomes gradually slower towards the end. In fact, the same class of causes that alters the rhythm in bronchitis and emphysema alters it in the diseases now under review.

In pleuritis and pleuritic effusion, and pneumothorax, the expiration is often retained at first by the involuntary contact of the vocal chords. These suddenly separate with a vocal cry or moan, and the expiration then rushes out very quickly at first, owing to the forcible expulsive action of the expiratory muscles. The same disturbance is met with in pleurodynia, pneumonia, peritonitis, and some other ailments, in which an inspiration excites pain, and the involuntary expiratory vocal efforts just described.

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motion, or even reversed motion, of the diaphragm on the affected side is often an indication of pneumonia affecting the base of the lung.—August, 1848.

In phthisis, the accumulation of fluid in a cavity, or in the bronchial tubes, excites, as in bronchitis, prolonged expiration —quick at first, then slow, and of increasing slowness towards the end, when the narrowing of the air-tubes increases the obstruction from the presence of fluid. The mechanism of the prolonged expiration, slower towards the end, which often exists in phthisis, where there are cavities containing fluid, has been already inquired into. (p. 449-455.)

In phthisis, if there be no obstruction to inspiration and expiration from fluid in the bronchial tubes or cavities, the rhythm of respiration is not usually disturbed.

In pneumonia, I conceive that the rhythm will be disturbed in like manner under the like circumstances, although M. Collin states that, in pneumonia, the inspiration is prolonged.

I beg to refer to the remarks on the Rhythm of Respiration in Emphysema and Bronchitis for a more full inquiry into that subject. (p. 413.)

## PART IV.—EFFECT OF DISEASES OF THE HEART AND PERICARDIUM ON THE MOVEMENTS OF RESPIRATION.

### SECT. I.—*Effects of Pericarditis on the Movements of Respiration.*

In severe cases, when there is pericardial effusion and the free and attached pericardium are both involved, the central tendon of the diaphragm being inflamed, the motion of the abdomen at the centre may be diminished, absent or reversed during inspiration, and the movements of the left fourth, fifth and sixth cartilages may be reversed, (either wholly, or only at first,) abolished or diminished.*

The movements of the ribs of the right side, and of the

* *Postscript, August* 1848.—Dr. Barlow gave me the opportunity of seeing a patient of his with pericarditis, in whom the abdominal movement was only about ·1 in. below, and to the left of the xyphoid cartilage. In a case of pericarditis, attended by Dr. Barlow, the lad finding relief from it, had of himself put a band round his abdomen, so as to restrain the abdominal and diaphragmatic movement.

left superior thoracic ribs, are at the same time exaggerated.

The retraction of the sternum and of the left costal cartilages is due to the elongation and consequent collapse of the distended pericardial sac by the action of the diaphragm. The exaggerated costal expansion also tends to draw a portion of the fluid away from behind the sternum and the left costal cartilages, and they hence fall back, owing to atmospheric pressure.

If pericarditis be less extensive and acute, the action of the diaphragm and the movements of the left costal cartilages are still restrained, but to a less extent in proportion as the disease is slight or partial.*

## Sect. II.—*Effects of enlarged Heart on the Movements of Respiration.*

When the heart is materially enlarged, the expansion of the lower end of the sternum and of the cartilages and ribs

* The effect of diseases of the heart and pericardium on the movements of respiration :—

That the inspiratory descent of the heart may exist in *pericarditis*, even with extensive effusion, was proved by the cases of Redgate and Cummins; diagrams from whom, in life, are given at pp. 532, 534 of my paper in the Provincial Medical Transactions.

In both of these, the seat of the impulse was lowered during a deep inspiration,—in Redgate, from the first, second, and third intercostal spaces in the tranquil state, to the third and fourth spaces; and in Cummins, from the third and fourth spaces, to the fourth and fifth. We have here an absolute proof that the heart may descend during inspiration, in a case of pericarditis with effusion. The case of Cummins proves, however, that though the descent of the diaphragm is not prevented, yet the expansion of the chest on the affected side is restrained, as in him the axillary and sub-mammillary measurements of the right side increased during a deep inspiration, from 12·4 in. to 12·6 in., and from 13 in. to 13·4 in., while the left side was stationary at 12·6 and 13 in. The diaphragm, Redgate's case showed, may be also restrained; the descent of it on the right side being greater than on the left.

In only one of the cases of pericarditis that I have examined with the chest-measurer, Weldon (Table IV., Case 181), was the pericarditis uncomplicated with endocardial noises. His case was, in other respects, more

**in front and to the side of the cardiac region is restrained. The size of the heart does not permit the usual extensive forward expansion of the left lung.**

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complicated than the rest, as he suffered habitually from Laennec's emphysema, to which rheumatic pericarditis was superadded. I have grouped all the cases of pericarditis, endocarditis, valvular disease, and pericardial adhesions, into one table, to which I refer. By thus grouping them, cases of the same kind are kept together, and the influence of various modifications can be readily compared.

In Weldon, the exposed portion of the heart (the cardiac region) was small, and low down, being behind and to the left of the xyphoid cartilage. This was owing to the emphysematous lungs occupying the space normally occupied by the heart. The chief modifications in the movements of respiration were those of emphysema. The lower end of the sternum at first retracted and then advanced during an inspiration. The peculiarity in the movements, manifestly introduced by the pericarditis, was an additional falling back of the left sixth cartilages compared with the right. While the right retracted ·03 in., the left fell back ·05 in.; and while the right fourth cartilage advanced ·05 in., the left receded ·02 in. at first and then advanced ·02 in. The retraction was here in part due to the emphysema; and, over the left side, in part to the pericarditis. In Hibbert and William Shaw, aged 15, (Table IV., Cases 182-3,) there was rheumatic pericarditis, without effusion, with faint endocardial murmur—aortic in Hibbert, mitral in Shaw. In both of these, the sternum, and the left fourth and sixth cartilages, receded during inspiration, either at the beginning only, or during the whole time, while the motion on the right side was nearly normal. In Lee, Thorley, and Benson, (Table IV., Cases 185, 186, 188,) the heart was enlarged, with some little pericardial effusion; and there were pericardial friction sounds, with exocardial murmurs. In these, as in the others, the motion of the left sixth and fourth costal cartilages was either less than that of the right, or was absent or reversed during inspiration. In all the cases, there was more or less restraint in movement of the abdomen at the centre, while, at the sides, it was scarcely affected.

In Thorley, the abdomen advanced at the centre, on the first examination, ·07 in. At a later examination, when he suffered much from pain and dyspnœa, the abdomen, at the centre, fell back ·1 in. during inspiration; at the side, it scarcely moved. Here the motion of the diaphragm was paralysed at the centre, and almost at the sides. The action of the diaphragmatic ribs was very slight, while the advance of the whole right ribs, and of the upper thoracic left ribs, was much exaggerated.

In the interesting case of a girl, with the examination of which I was favoured by Dr. Gill, suffering from pericarditis, with extensive effusion, the abdomen fell back at the centre during inspiration.

According to Dr. Stokes, muscles, when inflamed, are paralysed. This

If the heart be very large, the lower end of the sternum and the adjoining left cartilages may sometimes recede slightly during inspiration. The descent of the diaphragm is freely permitted both in front and to the sides.*

## Sect. III.—*Effects of enlarged Heart with Pericardial Adhesions on the Movements of Respiration.*

If there be pericardial adhesions with valvular disease and enlargement of the heart, the costal expansion in front of the

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is borne out in these cases, where the central tendon of the diaphragm was inflamed, and the action of the diaphragm arrested. The diaphragm fell back, in Thorley's case, on the same principle that the sternum fell back when the diaphragm was active, in hiccough, narrowed larynx, and emphysema. In the latter cases, atmospheric pressure forced back the ribs over the lengthened and collapsed lung; in the former case, the abdomen over the widened and shortened lung. In Thorley's case, the heart's impulse was scarcely lessened above during inspiration, on the second examination, when the diaphragm was inactive; and friction sounds were heard just over the heart. Partial adhesions were probably being formed.

The case of Clark is almost an exception. In reality, the active pericarditis had ceased before its existence was discovered. All the general signs of illness had disappeared. Health was returning, but there was a loud to and fro friction sound, like the rubbing of fine emery paper over the cardiac region. It was evident that active disease had disappeared, and that there was left merely the roughness of the membranes no longer inflamed; in a fortnight, the friction sound disappeared.

* Effect of enlargement of the heart with valvular disease on the movements of respiration:—

In the cases of John Illston and Mary Tomlinson, of whom diagrams are given in my paper on the Position of the Viscera, pp. 652-4, the heart and the left lung descended, as well as the right, to the normal extent during a deep inspiration; the heart's impulse descending in Tomlinson from the third, fourth and fifth intercostal spaces, to the sixth intercostal space, and behind, below and to the left of the xyphoid cartilage.

In the cases of Simmonds, Roe, Soar, and Leavers, (Table IV., Cases 194, 192, 195, 193,) affected with valvular disease and enlargement of the heart, the movements of the left costal cartilages over the cardiac region and of the lower end of the sternum were restrained, while, excepting in Simmonds, the expansion of the superior thoracic ribs and of the whole right side was exaggerated.

In Simmonds, there was mitral regurgitation, but the heart was scarcely enlarged, and the respiratory movements were but little restrained.

heart is restrained, the lung cannot pass in front of the heart, the descent of the diaphragm is restrained, and the heart's impulse is little or not at all lowered at its upper part.

While the movements of the centre of the chest and abdomen are restrained, the lateral superior movements of the former and the lateral movements of the latter are not restrained.

In cases where the pericardial adhesions are firm and the heart enlarged, the advance of the sternum during inspiration is restrained by the adhesions. The action of the diaphragm from below, and of the costal expansion from the sides, withdraws a portion of the heart from behind the sternum; the heart collapses, and as the expanding lungs cannot interpose themselves between the heart and the ribs and sternum, the sternum, especially at its lower end, and the adjoining costal cartilages, especially the left, fall backwards during inspiration.

Owing to the adhesions and the consequent non-intervention of the lungs during inspiration, the extent of the impulse is not lessened above during inspiration. The intercostal spaces which may sometimes be seen to fall in over the lungs during inspiration do not fall in over the heart.

These signs will sometimes enable us to distinguish whether, when the heart is enlarged, there be adhesions or not.*

* Effect of pericardial adhesions on the movements of respiration :—

When the adhesions are loose, the heart free from valvular disease and normal in size, I do not suppose that pericardial adhesions will materially influence the breathing movements.

It is otherwise when they follow a severe attack of rheumatic pericarditis, are firm, and are accompanied by valvular disease and enlargement of the heart.

W. Shaw, (Table IV., Case 197,) aged 14, was just such a case. In him the lower end of the sternum and the adjoining cartilages protruded. The heart's impulse, which was visible in the epigastrium, threw the whole cardiac region violently forwards, with a rapid fall after the systole. The whole sternum fell back during inspiration. The abdominal movement at the centre was restrained, while at the sides it was exagge-

## PART V.—THE VARIOUS CAUSES THAT MAY EFFECT ANY PARTICULAR ABNORMAL MODIFICATION OF THE RESPIRATORY MOVEMENTS.

In the progress of this inquiry into the movements of respiration in disease, I have taken the various diseases in their classes, and singly, and endeavoured to ascertain what effect each has in modifying the breathing movements.

I purpose here, in concluding the inquiry, to view rapidly, in their aggregate, the various morbid causes that may effect each particular deviation from the healthy movements of respiration.

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rated. He died. The pericardium was universally adherent. The mitral valves were diseased.

In other cases of adherent pericardium with enlarged heart, I have observed that the impulse was not lowered or lessened above during a deep inspiration.

In Bower, (Table IV., Case 199,) I infer that the pericardium was adherent—the heart being enlarged, the aorta regurgitant—because the impulse, which was very extensive, did not lessen in extent during inspiration. The intercostal spaces fell in over the lungs at each inspiration; their retraction stopped short suddenly at the margin of the cardiac region, just as it did at the upper boundary of the liver. In Bower, as in Shaw, the impulse was strong and heaving—returning suddenly. The region of the cardiac dulness extended considerably to the right of the sternum. In him the sternum at its lower end and the adjoining cartilages, especially the left, retracted during each inspiration; at the same time the sixth and eighth ribs fell in to the side, the left more than the right; while the diaphragmatic ribs and the abdomen to each side moved very freely outwards. The motion of the abdomen at the centre was very much restrained, being only ·15 in., one half its usual amount; while that of the sides was ·18 and ·2 in., right and left, being double the normal amount of motion.

The restraint of the diaphragm at the centre and in front is evidently due to the physical obstacle to its descent in the large and adherent heart, while the posterior portion of lung is, for compensation, called more freely into play, and is not interfered with in its descent.

In Bower, and also in Ellis, (Table IV., Case 198,) an old man who died with pericardial adhesions following pericarditis, the head was markedly lowered (in Bower ·02, in Ellis ·03 to ·05 in,) during each inspiration.

In pericardial adhesions with enlargement, the advance of the sternum is restrained by the adhesions. The action of the diaphragm from below, and of the costal expansion from the sides, withdraws a portion of the heart from behind the sternum, the heart collapses, and the sternum falls back.

*Causes that arrest or restrain the Diaphragmatic Movements, and exaggerate the Costal Expansion, during Inspiration. Arranged as the effect is greater or less.*

Peritonitis, especially of the diaphragm.
Pericarditis, especially of the central tendon of the diaphragm.
Pleuritis affecting the diaphragm.
Pericardial adhesions, with enlarged heart.
Aneurism of the abdominal aorta, close to the diaphragm.
Tumours attached to the diaphragm.

Ascites, Flatus, Ovarian tumours, } When they distend the abdomen so as materially to push up the diaphragm.

Paraplegia (?) if the phrenic nerves be involved in disease.

*Causes that restrain the Costal Movements symmetrically, and exaggerate the Diaphragmatic.*

1. Injuries to the spinal marrow, just below the fourth cervical vertebra.
2. Obstructions in the breathing-passages, either the nostrils, fauces, larynx, or trachea.

In hanging, or suffocation, hiccough at the beginning of the act; and in the fits of hysteria, during the violent struggles, when the vocal chords come together, during an attempt at inspiration,—the diaphragm acts with its whole force, draws down and elongates the yielding lungs, which collapse because air cannot enter them, and the chest retracting, is flattened and narrowed by the pressure of the atmosphere.

In croup, the hoop of hooping-cough, the crowing inspiration in children, in hysteria, and in the return noise made during inspiration by exhausted public speakers, described by Mr. Bishop,—the diaphragm acts forcibly, but with less power; the air is not absolutely excluded, but so little is admitted, that the sternum, especially the lower end of it, and the adjoining cartilages, fall back during inspiration.

In œdema glottidis, laryngitis, swollen palate, and obstructed nostrils,—according to the degree of the obstruction is the like result obtained.

In these cases expiration is usually prolonged, and is in general equally slow through the whole act.

*Causes that restrain the Movements of the lower end of the Sternum, and the Intermediate sets of Ribs, and exaggerate those of the Diaphragm, and the superior Thoracic Ribs.*

Obstructions in the smaller air-tubes.

In emphysema and bronchitis, respiration is impeded,—inspiration most at the beginning, expiration at the end, when the small tubes are the narrowest, and the obstruction they offer is greatest.

In these cases, the diaphragm draws down and elongates the lungs, at the same time that the superior thoracic ribs amplify them upwards.

These actions are performed more rapidly than air can enter; consequently, the lungs collapse, and the chest falls in at the lower end of the sternum and the sixth, fifth and fourth costal cartilages—that is to say, between the two expanded portions.

In healthy infants, the lower end of the sternum falls in during inspiration, especially if the abdomen be large, and the inspiration quick.

In ricketty children, the ribs and cartilages, and the sixth, seventh, eighth and ninth ribs, bend in at their articulation during inspiration, and the sternum protrudes.

In emphysema and bronchitis, if the lower end of the sternum be prominent, and the adjoining sides of the chest sloping, the sixth, seventh and eighth ribs fall in at the side, and the lower end of the sternum protrudes during inspiration.

*Cause that restrains the Thoracic Ribs of both sides.*

Posterior spinal curvature.

*Causes that may arrest or restrain the Costal and Diaphragmatic Respiratory Movements of the whole of one side, those of the opposite side being exaggerated.*

Obstruction in the right or left bronchus.

Emphysema and bronchitis of the whole of only one lung.

Pleuritic effusion and pneumothorax distending the whole of one side.

Condensation of the whole of one lung, usually from strong pleuritic adhesions, following empyema.

Consolidation from phthisis, combined with cavities and tendinous adhe sions of the whole of one lung.

Pneumonia, especially if both lobes be involved.

Extensive external injury to the whole of one side (fractured ribs).

Extensive pleurodynia.

Lateral curvature of the spine.

Hemiplegia (?).

*Causes that may restrain the Respiratory Movements of the five superior or Thoracic Set of Ribs, in whole or part, of either side, all the other Movements being exaggerated.*

Phthisis in all its stages, affecting one upper lobe.

Pneumonia of one upper lobe.

Pleuritis of one upper lobe.

Obstruction in the bronchial tube leading to either upper lobe.

Injuries or diseases of the ribs, or of the parts contiguous, if the movements of the ribs in question cause pain or mischief.

*Causes that may restrain the Respiratory Movements of the Sixth, Seventh and Eighth Ribs, or Intermediate Set.*

Pneumonia of the lower lobe.

Pleuritis of the lower lobe.

Partial pleuritic effusion.

Condensation of the lower lobe; dense pleuritic adhesions.
Peritonitis.
Local injuries.

The motion of the sixth rib may be restrained by disease of the upper part of the lower lobe, and lower part of the upper lobe.

*Causes that may restrain the Diaphragmatic Ribs of one side during Inspiration.*

Inflammation of one side of the diaphragm (pleuritic or peritoneal).
Pneumonia of the lower lobe—its lower part.
Any cause that may restrain the movement of one side of the diaphragm.

*Causes that may produce retraction of the whole Sternum, and, more or less, the adjoining Cartilages, during Inspiration.*

Obstruction to respiration in the outer air-passages.
Pericardial effusion—extensive.
Pericardial adhesions—universal, with enlarged heart.
Pleuritic effusions—universal.
Phthisis affecting the whole of one lobe.
Extensive injuries to the ribs.

*Causes that may produce retraction of the lower end of the Sternum.*

The same causes that may produce retraction of the whole sternum, when less severe.
Emphysema and bronchitis.
Condensation of the whole of one lung.

*Causes that may restrain the motion of the left superior Thoracic Ribs.*

Pericardial effusion; pericardial adhesions.
Excessive distention of the stomach.

*Causes that may restrain the Motion of the Intermediate Set of Ribs (sixth and seventh) on the left side.*

Pericarditis—pericardial effusion.
Enlarged heart—pericardial adhesions.
Distention of the stomach—enlargement of the spleen.

*Causes that may restrain the Motion of the left Diaphragmatic Ribs (ninth, tenth, eleventh, and twelfth,) and the left side of the Diaphragm.*

Distention of the stomach.
Enlargement of the spleen.

*Causes that may restrain the Movements of the Right Thoracic Ribs.*

Enlarged liver from adventitious deposits; adherent liver.

These causes may also restrain the movements of the right intermediate and diaphragmatic ribs and the right side of the diaphragm.

*Causes arresting the right fourth, fifth and sixth Cartilages and Ribs.*

Pneumonia of the middle lobe.
Cavities in the middle lobe.

The motion of any rib, or set of ribs, may be restrained or arrested by various modifying causes, while all the rest of the respiratory movements are exaggerated.

The following admirable remarks, made by M. Andral, in his Clinique Medicale, (tom. ii. p. 98,) comprise everything that has been said, or need be said, on this subject:— "Cette immobilité partielle de quelques côtes n'est pas sans interêt sous le simple rapport physiologique. Ce fait ne prouve-t-il pas que dans l'inspiration les côtes peuvent se mouvoir indépendamment les unes des autres, et qu'elles n'ont pas seulement un mouvement commun? Si, comme nous l'avons vu souvent sur les phthisiques, les côtes inferieures peuvent se mouvoir encore lorsque les supérieures restent immobiles, cela prouve qu'indépendamment de l'action des scalènes, que nous ne nions point dans l'état ordinaire, les muscles intercostaux sont susceptibles à prendre une part active dans l'acte de l'inspiration."

The independence of each intercostal muscle of the action of the scalenus, and the muscles above it, is here affirmed and proved.

## PART VI.—ON THE DIAGNOSTIC VALUE OF THE OBSERVATION OF THE MOVEMENTS OF RESPIRATION.

From the many diseases that derange the movements of respiration, from the multifarious varieties of those disturbed movements, and from the same disturbance being produced by different diseases, it is manifest that we cannot form a diagnosis by observing the arrest, restraint, or exaggeration of any particular respiratory movement. While we cannot, however, be thus directed to a final diagnosis, we have made a first good step towards it. We have shut out a number of diseases, of which the existence is disproved by a modification in the respiratory movements, opposite to that which they produce. We have narrowed our inquiry, and isolated it to a certain small class, one or other of which must

be the cause of the deranged movement. The seat of the disease is made out by the inquiry. If we see the movements arrested or restrained over the left upper lobe, we examine that lobe; if that be healthy, we inquire successively whether the heart be diseased, the lower lobe of the lung inflamed, the stomach distended, the intercostal muscles, the ribs, or the neighbouring parts, be injured or diseased, or in pain. If we find that the part of the organ of which the function is arrested be not diseased, we look, in a widening inquiry, for those diseases, or injuries, or malformations, to which the movements of the parts in question would be adverse. Each of these disturbing causes must of course be distinguished by its individual diagnostic signs.

In the *ordinary involuntary respiratory movements*, there are two points to be inquired into—what movements are restrained, and what exaggerated? If respiration be arrested, or restrained, in one part, the exaggeration elsewhere usually more than compensates for the local diminution. The degree of the local exaggeration is usually in proportion to the activity of the disease. If the descent of the diaphragm is restrained by a chronic cause, as in ovarian dropsy, the movements of the thoracic ribs are somewhat exaggerated, but if it is arrested, or restrained, by peritonitis, the exaggeration is much greater, both in effort, frequency, and movement.

The arrest, or restraint, of the involuntary respiratory motion in one part of the chest produces exaggerated motion in all the other parts.

If the motion of any part of the chest be reversed,—as it is in Laennec's emphysema, and laryngeal obstruction over the lower part of the sternum,—we have an almost certain indication that there is some thoracic disease.

*Deep voluntary inspiratory movements.*—While the derangement of the involuntary breathing-movements gives us certain information, including the possibility of several diseases, and excluding that of all others, the knowledge of the extreme movements during a deep inspiration gives us reasons for setting aside other diseases previously considered possible.

If the movements of any part be restrained during an ordinary inspiration, and yet normal during a deep inspiration, the restraining cause can only be slight.

If the movements, during a deep inspiration, be restrained at one part, and free everywhere else, we may exclude certain acute diseases, as peritonitis and pericarditis, which, while they exaggerate ordinary breathing, are incompatible with a greatly increased deep inspiration.

The extreme movement during a deep inspiration corresponds to the extreme breathing-capacity as ascertained by the spirometer. In fact, in ascertaining this circumstance, the chest-measurer is an imperfect pocket-spirometer which, while it cannot tell the exact capacity, has the additional faculty of localising the diminished movement, if it be local, or of showing it to be diffused over the whole breathing apparatus.

In inquiring into the extreme respiratory movements, we must not overlook the want of control which some persons have over their respiratory movements, who sometimes breathe solely by the ribs, at other times solely by the diaphragm. The best plan with such persons is to direct them by example.

*The rhythm of respiration.*—If the rhythm of respiration be disturbed, we gain positive information that the disease belongs to a certain small class.

If the inspiration be laborious, the expiration slow, and equally slow throughout, we know that there is obstruction in the breathing-passages, as the larynx or fauces.

If the inspiration be laborious and rather quick, and the expiration prolonged, quick at first and then slow, and gradually slower towards the end, we know that there is obstruction to respiration in the smaller bronchi, as in emphysema, bronchitis and phthisis. In emphysema the obstruction is constant; in bronchitis it is sometimes absent during a short interval, after getting rid of the sputa; and in phthisis it is only present when there is fluid in the bronchi or the cavity.

In many painful diseases, the expiration is at first inter-

rupted, the glottis being closed by the vocal chords; these part with a moan, and the expiration gushes out quickly at first, becoming gradually slow.

In peritonitis, the expiration may be quicker than the inspiration.

The information given by the rhythm of respiration is a valuable assistant to that given by its motion. If the motion be anywhere restrained and the rhythm invariably normal, there is good reason for anticipating that the lungs are free from disease; on the other hand, if the expiration be materially prolonged, we know that the respiratory organs are in fault.

The knowledge furnished by the deranged movements and rhythm of respiration defines the seat of the disease, but not its nature. To ascertain this, the other aids to diagnosis must be employed. This knowledge is the first step in the inquiry, which it does not prolong, but, on the contrary, shortens, as it directs the attention to the affected part.

In this inquiry I have found the chest-measurer essential. For ordinary observation, the educated eye-sight and touch will usually furnish all the needful information. It is in the cases of doubt and difficulty, and especially in persons really healthy, though supposed by themselves to be diseased, that the chest-measurer is most serviceable.

In conclusion, I beg to thank the various medical men here and in London who have very kindly permitted me to avail myself of their cases; and my pupil, Mr. Martyn, who has with patient intelligence assisted me throughout in this inquiry.

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The figures in the Tables in the body of the paper indicate the respiratory movements during an ordinary inspiration, unless otherwise specified.

# EXPLANATION OF THE TABLES.

The figures on a line with each name, denote the respiratory movement during an ordinary (involuntary) inspiration.

The figures below those of ordinary inspiration, denote the extent of movement during an extreme inspiration.

The movements are given in hundredths of inches.

The tape measurements in inches and tenths of inches.

Figures separated by a line thus 2/5, denote an extent of motion varying from the one to the other.

The sign * prefixed, denotes a falling in of the costal walls.

The sign † prefixed, denotes a rising of the costal walls.

*1 †5 denotes a backward inspiratory movement of ·01 inch, followed by a forward movement of ·05 inch.

The figures under the head of Rhythm, show the relative duration of inspiration and expiration (ascertained by counting, see p. 418).

The figures above the ordinary tape measurements are those during expiration; those below, during inspiration.

N.B. The heading "Sixth costal cartilage" in the tables in the body of the paper correspond with the heading "Sixth rib, anterior" in these tables.

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For the method in which the measurements were taken, see pp. 364-366.

The Author's notes of the cases are accessible to any one interested in them.

## TABLE I.—*The Movements of Inspiration in Hea*

Males, pp. 367-370, 376-378.

| | Age | | Sternum. | | Second rib. | | Fourth and fifth ribs. | | Sixth rib, anterior. | | Sixth rib lateral | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | upper | lower | right | left | right | left | right | left | right | left |
| 1. J. Whitehead | 17 | had ophthalmia, well, robust health, chest healthy | 2<br>80 | 2<br>60 | 4<br>100 | 3<br>100 | 3<br>80 | 3<br>80 | 3 | 3 | 3 | 3 |
| 2. G. Withers | 29 | had lumbago, well, robust labourer, chest healthy | 3<br>80 | 5<br>50 | 6<br>100 | 6<br>100 | 2½ | 3 | 3 | 3 | ½ | ½ |
| 3. C. Webster | 22 | ophthalmia, nearly well, robust labourer, chest healthy | 3<br>100 | 6<br>90 | 3<br>100 | 3<br>100 | 4<br>105 | 4<br>100 | 6/7 | 6 | 5 | 4 |
| 4. J. Rushworth | 23 | healthy, chest healthy | *1†2<br>2/4<br>120 | 4<br>75 | 2/4<br>130 | 2/4<br>125 | 3/4<br>120 | 3/4<br>120 | 4<br>120 | 4<br>120 | 1 | 1 |
| 5. Charles Cook | 30 | dyspepsia, chest healthy | 4/6<br>35 | 3<br>50 | 5/7<br>70 | 5/7<br>70 | 3<br>40 | 2<br>45 | *2/ *1 †4<br>28 | *1 †4<br>28 | *1<br>*5 †35 | 0/7<br>*2 [illegible] |
| 6. J. Nettleship | 40 | dis. of urethra, robust labourer, chest healthy | 5<br>40 | 5<br>40 | 2/7<br>50 | 2/7<br>50 | 3/5<br>22 | 2/4<br>30 | 5/8 | 3/5<br>17/20 | 2/5<br>20/22 | 1/5<br>20/22 |
| 7. J. Proshaw | 30 | ulcer of leg, nearly well, chest healthy, remarkably well-made man | 5<br>95 | *1†6/6<br>*3 †35 | 8<br>100 | 7<br>100 | *1 †2/4 | *1 †5 | 5 | 5 | 6 | 4 |
| 8. W. Wainman | 28 | lumbago, nearly well, chest healthy | 2<br>100 | 5<br>120 | 3<br>115 | 3<br>115 | 3<br>120 | *1 †1<br>120 | 6<br>130 | 5<br>130 | 5<br>70 | *1 †3<br>70 |
| 9. W. Hutchinson | 37 | dyspepsia, chest healthy, general health good | 4<br>130 | 5<br>110 | 7<br>110 | 7<br>100 | 5<br>95 | 3<br>90 | 5<br>80 | 4<br>80 | 2<br>80 | 2<br>80 |
| 10. G. Berridge | 33 | affection of knee, well, chest healthy | 4<br>42 | 3<br>100 | 2/4<br>70 | 2/4<br>70 | 2/5<br>60 | 2/6<br>60 | 4/7<br>50 | 3/5<br>50 | 2<br>35 | 1<br>30 |
| 11. James Ward | 39 | lumbago, well, chest healthy | ½/2<br>50 | 5/4<br>50 | 2/5<br>60 | 7/10<br>60 | 2<br>50 | 1/2<br>50 | 2/5<br>70 | 2/4<br>60 | 2/3<br>40 | 1/2<br>40 |
| 12. Westall | 25 or 26 | splendid condition, runner, third best in England | 2½<br>180 | 4<br>190 | 5<br>225 | 4½ | 3½ | *1 †1 | 4 | 1 | ... | ... |
| 13. Seward | 25 or 26 | splendid condition, American runner, best in the world | 3<br>100 | 4<br>100 | 3<br>150 | 4 | 2 | 3 | 4 | 2 | ... | ... |
| 14. James Pacey | 17 | recovered from fever, chest healthy | 3 | 5 | 6 | 6 | 3 | *2 †3 | 7 | ... | ... | ... |
| 15. Geo. Wardell | 18 | recovered from fever, chest healthy | 1½ | 3 | 6 | 4 | 2 | 2 | 5 | 5 | ... | ... |
| 16. W. Attenburrow | 22 | healthy, robust, chest healthy | 5<br>90 | 2/3<br>60 | 8/10<br>100 | 8/10<br>100 | 5<br>100 | 3<br>100 | 3/5<br>50 | 2/3<br>40 | 4<br>65 | 3<br>60 |
| 17. J. O'Connell | 45 | ulcer of leg, out of health, chest healthy | 4/7 | 3/4 | 3/7 | 3/7 | 1/3<br>20 | 3<br>20 | 3<br>20 | 3½<br>20 | 1/3<br>20 | 3<br>20 |

*bserved by the use of the Chest-measurer*, pp. 364-378.

| Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. | | | | | | No. of respirations per minute. | Breathing capacity. | height. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | above nipple | | xyphoid cartilage | | Abdomen. | | | | |
| right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | | | |
| 5<br>70 | 6<br>70 | 5 | 5 | 8 | 25<br>100 | 9 | | | | | | | | | | c. in. | ft. in. |
| 4<br>40 | 4<br>40 | 3 | 3 | 10 | 25<br>100 | 6 | 4 | 4 | 18·2 | 18·2 | 17·4 | 17·4 | | | | | |
| 7 | 6<br>60 | 8<br>50 | 7 | 13 | 40<br>90 | 11 | 4 | 4 | 17·4 | 17·4 | 16·4 | 16·4 | | | | | |
| 6 | 5 | 7 | 8 | 10 | 20/28<br>100 | 10 | 5 | 5 | 16·5 | 16·2 | 16·8 | 16·9 | ... | ... | 24 | | |
| 4<br>20 | 4<br>26 | 8<br>28 | 6<br>45 | 6/8 | 25<br>70 | 8/14 | 6 | 6 | 16·3 | 16·3 | 16<br>16·7 | 15·5<br>15·8 | ... | ... | 20 | | |
| 8<br>35 | 5<br>35 | 7<br>8/12 | 5<br>8/12 | 5/8<br>12 | 25<br>100 | 3/6<br>12 | 5 | 5 | 16·2 | 16·2 | 16<br>17·1 | 16<br>17·1 | ... | ... | 20 | 190 | 5 4½ |
| 2 | 2 | 5 | 4 | 8 | 35 | 7 | 4 | 4 | 25 | 22 | 24 | 19·7 | ... | ... | 17 | 340 | 6 0½ |
| 10<br>130 | 10<br>130 | 8<br>80 | 8<br>80 | 7 | 25<br>100 | 7 | ... | ... | 14·2<br>...<br>15 | 14·2<br>...<br>15·3 | 13·5 | 13·5 | 12·2 | 11·8 | 20 | 185 | 5 6½ |
| 6<br>95 | 6<br>90 | 8<br>95 | 6<br>80 | 8<br>70 | 25<br>140 | 8<br>70 | 5 | 5 | 15·8<br>...<br>17·3 | 15·5<br>...<br>17·3 | 15·5 | 15·8 | 13·5 | 14·5 | 20 | 200 | 5 9 |
| 10<br>50 | 7<br>50 | 9<br>60 | 7<br>65 | 12/14<br>54 | 35<br>100 | 12/14<br>50 | 7 | 8 | 16·6<br>17<br>17·8 | 16·3<br>16·9<br>17·6 | 16·5 | 16·2 | 15 | 15 | 10 | 225 | 5 8½ |
| 4/5<br>32 | 4/5<br>18 | 4/5<br>22 | 3/9<br>25 | 5<br>26 | 20/30<br>100 | 11<br>20 | 5 | 5 | 18·1<br>17·3<br>16·7 | 17·9<br>19·1<br>16·4 | 17·3 | 16·9 | 13·8 | 13·8 | 22 | | |
| ... | ... | 5 | 5 | 12 | 30 | 12 | 5 | 5 | ... | ... | ... | ... | ... | ... | ... | 290 | 5 9<br>or<br>5 8½ |
| ... | ... | 6 | 6 | 9 | 30 | 8 | ... | ... | ... | ... | ... | ... | ... | ... | 25 | | 5 9 |
| ... | ... | 10 | 10 | 15 | 20<br>120 | 15 | | | | | | | | | | | |
| ... | ... | 6 | 7 | 17 | 24 | 15 | | | | | | | | | | | |
| 9/13 | 8 | 9 | 5 | 12<br>10 | 30<br>10 | 10/12<br>15 | ... | ... | 17·3 | 17·5 | 16·3 | 16·2 | | | | | |
| 3<br>16 | 8<br>16 | 5<br>30 | 8<br>30 | 3 | 25<br>100 | 9 | 4 | 4 | 17·3 | 17·3 | 18 | 18 | | | | | |

TABLE I.—*Health*

| | | Age | | Sternum. | | Second rib. | | Fourth and fifth ribs. | | Sixth rib, anterior. | | Sixth rib, lateral. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | upper | lower | right | left | right | left | right | left | right | left |
| Males. | 18. E. Houghton | 16 | disease of knee, robust, chest healthy | 12<br>50 | 5<br>110 | 3<br>90 | 2<br>70 | 3<br>60 | 1<br>90 | 5 | 4 | 3<br>95 | 3<br>70 |
| | 19. J. Curran | 44 | stricture of rectum, chest healthy, general health good | 4<br>80 | 3/4<br>50 | 3/5<br>60 | 3/5<br>60 | 4/7 | 4/6 | 4<br>50 | 3<br>50 | 3<br>60 | 3<br>80 |
| | 20. C. Coupe | 15 | healthy, florid, chest healthy | 7 | 6<br>40 | 9<br>100 | 9<br>95 | 7<br>80 | 5<br>70 | 6 | 5 | 5<br>50 | 2/3<br>40 |
| | 21. T. Plackett | 14 | healthy, chest healthy | 2/3 | *1 †2 | 0/4<br>50 | 0/2<br>60 | 0/2 | 0/ *1 | 2 | *2 †1 | *1/4<br>55 | *1,4<br>60 |
| | 22. S. Bingham | 15 | broken os humeri, robust | 3/8<br>60 | 5/10<br>70 | 0/3/8<br>100 | 0/2/6<br>80 | 5/10 | 3/8 | 10<br>100 | 10<br>95 | 8/14 | 8/14 |
| | 23. J. Eddishawe | 15 | burn, well, perfect health, chest healthy, collier, robust | 4<br>100 | *1 †4<br>70 | 4<br>100 | 2<br>90 | 2/5<br>50 | 2/4<br>50 | 2/4<br>50 | 2/4<br>50 | 2<br>40 | 1<br>30 |
| | 24. George Smith | 35 | perfect health, chest healthy, robust labourer | 5 | 4<br>100 | 5<br>130 | 3<br>120 | 5<br>120 | 2<br>80 | 6<br>70 | 4<br>70 | 4<br>80 | 3<br>70 |
| | 25. John Coupe | 11 | broken arm, nearly well, perfect health, chest healthy | 5<br>110 | 4<br>50 | 7/6<br>130 | 6/5<br>130 | 3<br>90 | 3<br>85 | 3<br>40 | 3<br>35 | 1<br>75 | 1<br>70 |
| | 26. J. Clarke | 10 | healthy, not strong, chest healthy | 3<br>70 | 5<br>50 | 5<br>100 | 5<br>100 | 3<br>100 | *1 †2½<br>100 | 3 | 2 | 1½ | 1 |
| | 27. W. Greenfield | 10 | disease of knee, pale, chest healthy | 0/3<br>30 | 1/2<br>33 | 0/3<br>30 | 0/3<br>30 | ... | ... | 2 | 2 | 1 | 1 |
| Males.—Cases in which breathing was exaggerated, pp. 369, 370. | 28. W. Green | 19 | dyspnœa, chest healthy | 10<br>50 | 5<br>50 | 16<br>80 | 16<br>70 | 10<br>80 | 12<br>60 | 5 | 5 | 5<br>70 | 3<br>60 |
| | 29. W. Stennett | 40 | compound fracture of leg, pale, chest healthy | 3<br>70 | 8<br>50 | 6<br>150 | 6<br>130 | 9<br>105 | 8<br>105 | 10 | 9 | 6 | 6 |
| | 30. J. Clay | 43 | sciatica, chest healthy | 7/10<br>80 | ... | 10/20<br>95 | 10/20<br>100 | 15/20<br>80 | 12/20<br>75 | 15<br>80 | 15<br>80 | 10/15<br>50 | 6/13<br>50 |
| | 31. T. Glossop | 14 | delicate, pale, chest healthy | 12/25 | 10/25 | 15/40 | 10/30 | 5/30<br>50 | 5/30<br>50 | 15/26 | 18/29 | 16/25 | 12/20<br>20 |
| | 32. W. Stevenson | adult | lumbar pain, pale, chest healthy | 4/15<br>50 | 4/4<br>60 | 8/20<br>70 | 5/16<br>70 | 5/12<br>80 | 3/8<br>75 | 4<br>60 | 4<br>60 | 8<br>80 | 8<br>70 |
| | 33. J. Beaumont | 40 | ulcer of leg, health good, chest healthy | 8<br>75 | 11<br>50 | 6<br>100 | 10/2<br>95 | 8<br>60 | 6<br>50 | 25 | 60 | 2 | 6 |
| | 34. W. Herod | 19 | diseased ankle, chest healthy, delicate | 9<br>100 | 7<br>95 | 12<br>100 | 14<br>100 | 3<br>90 | 2<br>65 | 5<br>100 | 4<br>70 | ... | ... |
| | 35. S. Varney | 37 | chest healthy | 10 | 8 | 10<br>90 | 12 | 6 | 3 | 6 | 5 | ... | ... |
| | 36. John Wilson | 50 | ulcer of leg, fair health, fat, chest healthy | 6 | 8/15<br>70 | 4/8<br>70 | 5/10<br>80 | *1 †5/15<br>40 | *1†5/*10<br>45 | 10<br>56 | 8<br>50 | *1 †3<br>40 | *2 †3<br>50 |

ntinued.

| Eighth rib, | | Tenth rib, | | Abdominal, | | | Rhythm, | | Tape measurements, above nipple | | Tape measurements, xyphoid cartilage | | Tape measurements, Abdomen, | | No. of respirations per minute, | Breathing capacity, | height, |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | | c. in. | ft. in. |
| 12<br>100 | 8<br>75 | 12<br>60 | 6<br>45 | 14 | 25<br>*30+40 | 8 | ... | ... | 16·2 | 16·2 | 16·6 | 16·3 | | | | | |
| 3<br>55 | 3<br>50 | 3<br>55 | 2<br>54 | 7 | 16/25<br>40 | 3/6 | ... | ... | 17 | 17 | 16 | 15·3 | | | | | |
| 6/9 | 5/8 | 8 | 6/7 | 12<br>30 | 28<br>100 | 10<br>20 | 5 | 5 | 13·5 | 13·2 | 13·4 | 13·3 | | | | | |
| 0/15<br>60 | 4/8<br>60 | 4/8<br>60 | 4/8 | 8/12 | 50/60<br>20 | 8/12 | 6 | 6 | 14 | 14 | 13·8 | 13·6 | ... | ... | 13 | 136 | 4 10 |
| 10<br>90 | 9<br>75 | 12<br>80 | 10<br>70 | 7<br>30 | 45<br>70 | 5<br>30 | 4 | 4 | 13·1<br>...<br>14·8 | 12·8<br>...<br>14·2 | 13·5<br>1 | 13·5 | 12 | 11·5 | 20 | | |
| 7<br>40 | 7<br>40 | 4<br>40 | 4<br>40 | 9<br>45 | 25<br>120 | 9<br>45 | 4 | 6 | 14<br>15 | 13·3<br>14·5 | 14·2 | 14 | 12·5 | 12·5 | 22 | 130 | 4 11½ |
| 6<br>10 | 6 | 16<br>60 | 6<br>20 | 12<br>70 | 35<br>80 | 8<br>40 | 4 | 4 | | | | | | | | | |
| 5<br>60 | 5<br>60 | 6<br>35 | 6<br>25 | 10<br>25 | 26<br>50 | 8<br>30 | 5 | 6 | 14·4<br>13·2 | 14<br>13 | 12·9 | 12·7 | 12·1 | 12·1 | 20 | 110 | 4 7½ |
| 5½<br>50 | 5<br>50 | 7 | 6 | 9 | 40 | 7 | 4 | 4 | 12·6 | 12·6 | 13 | 13·2 | | | | | |
| 7 | 6 | 6 | 6 | 10/16 | 20/40<br>30 | 8/16 | 4 | 4 | 12 | 12 | 11 | 11½ | | | | | |
| 10<br>70 | 8<br>70 | 10<br>40 | 8<br>40 | 9 | 18<br>20 | 8 | ... | ... | 16 | 17 | 16 | 16 | ... | ... | ... | 185 | 5 6½ |
| 11/9<br>70 | 15<br>70 | 9 | 8 | 9 | 20 | 6 | 4 | 4 | 17·2 | 17·2 | 17 | 16·4 | ... | ... | 13 | | |
| 20/30<br>60 | 20/30<br>60/55 | 30 | 30 | 40 | 90<br>100<br>to<br>150 | 30/40 | 9 | 9 | 16·5 | 16·5 | 16·5 | 16·5 | ... | ... | 9 | | |
| 10/20<br>20 | 10/20 | 3/7<br>27 | 3/7<br>27 | 10/15<br>32 | 60/90<br>80 | 6/12<br>28 | ... | ... | 12·3 | 12·3 | 12 | 12 | ... | ... | 23 | | |
| 10 | 10<br>70 | 10<br>65 | 9 | 4 | 15<br>90 | 4 | 8 | 8 | 15·2 | 15 | 16 | 15·4 | ... | ... | ... | 208 | 5 7½ |
| ... | ... | 7 | 7 | 25 | 60<br>160 | 25 | 6 | 6 | | | | | | | | | |
| ... | ... | 7<br>20 | 4<br>20 | 8<br>30 | 30<br>70 | | | | | | | | | | | | |
| ... | ... | 7 | 6 | 14 | 25<br>100 | 13 | | | | | | | | | | | |
| 10 | 11 | 9<br>42 | 7<br>35 | 11<br>11/15 | 45<br>100 | 8<br>8/12 | ... | ... | 17 | 17 | 18 | 17·8 | | | | | |

TABLE I.—*Heal*

| | | Age | | Sternum. upper | Sternum. lower | Second rib. right | Second rib. left | Fourth and fifth ribs. right | Fourth and fifth ribs. left | Sixth rib, anterior. right | Sixth rib, anterior. left | Sixth rib, lateral. right | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male. | 37. T. Goodrich | 53 | healthy, fat, chest healthy | 7/20 | *5/*15 | ... | ... | 10 | 10 | *10/ *20 | *8/*20 | --- | |
| Old Men, pp. 370, 371. | 38. Wm. Spick | 53 | healthy, chest healthy | 5<br>50 | 3 | 5/8 | 5/7 | 4 | 3 | 7 | 7 | --- | |
| | 39. W. Bednall | 61 | cataract, health perfect, chest healthy | 8<br>90 | 10<br>90 | 7/10<br>75 | 7/10<br>70 | 8/15<br>80 | 8/15<br>80 | 9<br>60 | 7<br>60 | 7<br>60 | |
| | 40. J. Wiles | 68 | sciatica, slight cough, chest healthy | 10/12<br>100 | 6/14<br>80 | 10<br>50 | 10<br>50 | 10<br>75 | 5<br>75 | 10<br>50 | 5<br>50 | 10<br>25 | |
| | 41. J. Shawcroft | 65 | ulcer of leg, well, health good, heart large, lungs healthy | 10/12<br>80 | 12/15<br>90 | 6/9<br>50 | 6/9<br>40 | 9/10<br>80 | 7/8<br>45 | 10<br>75 | 7<br>35 | 8<br>75 | |
| | 42. S. Mart | 71 | ulcer of leg, nearly well, fat, health tolerable, chest healthy | 7/10<br>50 | 6/9<br>50 | 12/13<br>55 | 12/13<br>55 | 4/6<br>35 | 4/7<br>20 | 4<br>20 | 4<br>20 | 3/5<br>20 | |
| | 43. L. Lane | 64 | had erysipelas in axilla, nearly well, excellent health, robust, chest healthy | 2/4<br>25 | 1/2<br>10 | 1½<br>21 | 3<br>30 | 0/1½ | 0/1½ | 1<br>15 | 1<br>14 | 3/0 | |
| | 44. J. Marshall | 65 | hernia, healthy, robust, chest healthy | 10 | 14 | 10 | 10 | 10 | 6 | 13 | 12 | --- | |
| Females, pp. 372-374. | 45. J. Goodall | 35 | cataract, hysterical, healthy chest, stays on | 15/20<br>70 | 7<br>15 | 10/18<br>70 | 12/20<br>70 | ... | ... | ... | ... | 4<br>10 | |
| | | | stays off ... ... | *2 †7<br>35 | 3/4<br>30 | 6/8<br>50 | 6/8<br>50 | ... | ... | ... | ... | 2/3<br>10 | |
| | 46. J. Green | 20 | had fistula, nearly well, perfect health, chest healthy, stays on | 6/10<br>50 | 3/4<br>20 | 6/8/10 | 6/8/10 | ... | ... | ... | ... | 3<br>10 | |
| | | | stays off ... ... | 3/10 | 3/10<br>35 | 3/10<br>50 | 3/10<br>50 | ... | ... | 2/6 | 2/6 | 3<br>10 | |
| | 47. E. Ball | 25 | hysterical affection of knee-joint, health good, chest healthy, stays on | 6/10<br>60 | 3/5<br>20 | 6/12 | 5/11 | ... | ... | ... | ... | 2<br>12 | |
| | | | stays off ... ... | 7<br>70 | 5<br>70 | 8/15 | 8/15 | ... | ... | ... | ... | 3/4 | |
| | 48 M. Daft | 17 | purpura, improving, chest healthy, stays off | 5<br>35 | 4<br>30 | 6<br>45 | 6<br>45 | ... | ... | ... | ... | 0/1<br>26 | |
| | 49a. E. Elsom | 11 | healthy, chest healthy, stays on | 8<br>50 | 4<br>30/40 | ... | ... | ... | ... | ... | ... | ... | |
| | 49b. E. Elsom | | stays off ... ... | 6/7<br>50 | 2/5<br>30 | 10<br>60 | 10<br>60 | ... | 3<br>30 | *1 †3<br>25 | 3/5 | *1 †2<br>*1 †3 | |

ntinued.

| Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. above nipple | | xyphoid cartilage | | Abdomen. | | No. of respirations per minute. | Breathing capacity. | height. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | | c. in. | ft. in. |
| ... | ... | 3 *6 | 3* 6 | ... | 20<br>30 | ... | ... | ... | ... | ... | 10·2 | 10·2 | 10 8 | 10·8 | | | |
| ... | ... | 6 | 6 | 20 | 40<br>95 | | | | | | | | | | | | |
| 12<br>60 | 11<br>60 | 10<br>22 | 8<br>22 | 8 | 30<br>50 | 6 | 6/7 | 10/11 | 15·2<br>16<br>16·7 | 15·5<br>16<br>16·7 | 15·4 | 15 6 | 13·7 | 14 | 12 | | |
| 10<br>30 | 5<br>25 | 4 | 3 | 12 | 50<br>90 | 5 | 6 6 3 | 6 9 | 14 4<br>15 1<br>15·7 | 14·5<br>15·2<br>15·8 | 14·8 | 14·5 | 13·8 | 14 | 16 | 150 | 5 7½ |
| 20/22<br>30 *10 | *1 †5<br>30 *10 | 8<br>*10 †20 | 4<br>*20†15 | 8<br>*10†20 | 35<br>100 | 5<br>*10†15 | 6 | 7 | 15·3<br>15·6<br>16·5 | 15·4<br>15·7<br>16 | 15·5 | 15·4 | 14·5 | 14·5 | 22 | | |
| 5/7<br>5/10 | 3/4<br>*8 | 7<br>2/4 | 4<br>2/2 *2 | 5/6<br>20 | 35<br>110 | 5/6<br>5 *5 | 6 | 7 | 19<br>19·3 | 18·7<br>19 | 19·2 | 18·8 | 16 | 16•2 | 18 | | |
| 4/5<br>*2 †3 | 2<br>*10 | 4/5 | 1/2 | 8 | 25/40<br>70 | 3 | 8 | 8 | 16·9 | 16·9 | 17·2 | 17·2 | 14·9 | 15·2 | 20 | | |
| ... | ... | 10 | 5/9 | 20 | 30 | 20 | | | | | | | | | | | |
| ... | ... | ... | ... | ... | 7/8<br>70 | ... | 7 | 8 | 30<br>30·6 | 30<br>30·6 | 25<br>25·5 | 25<br>25 5 | ... | ... | 14 | | |
| ... | ... | ... | ... | ... | 15/20<br>50 | ... | ... | ... | 30<br>30·5<br>31 5 | 30<br>30 5<br>31 5 | 25<br>26 | 25<br>26 | | | | | |
| ... | ... | ... | ... | ... | 8/11<br>30 | ... | 8 | 8 | 33<br>33·5 | 33<br>33·5 | 26<br>26 5 | 26<br>26 5 | ... | ... | 20 | | |
| ... | ... | ... | ... | ... | 15/20<br>50 | ... | ... | ... | ... | ... | 14<br>14·3 | 13·7<br>14 | 14·5<br>15 | 14·5<br>15 | | | |
| ... | ... | ... | ... | ... | 10<br>60 | ... | ... | ... | 34<br>35·5 | 34<br>35·5 | 29<br>29·3 | 29<br>29·3 | ... | ... | 24 | | |
| ... | ... | ... | ... | ... | 12/25 | ... | 6 | 8 | 33·3<br>34<br>35·5 | 33·3<br>34<br>35·5 | 30<br>39·5<br>39·5 | 30<br>39·5<br>39·5 | | | | | |
| ... | ... | ... | ... | ... | 15/20<br>70 | ... | 8 | 8 | 13·5<br>27·8 | 13·3<br>27·8 | 12·5 | 12 | 25 | 25 | 18 | | |
| ... | ... | ... | ... | ... | 10<br>50 | ... | 5 | 8 | | | | | | | | | |
| ... | ... | ... | ... | ... | 20<br>66 | ... | ... | ... | 12<br>12·3<br>12·6 | 11·8<br>12·1<br>12·3 | 12 | 11·8 | 10·8 | 10·8 | | | |

TABLE I.—*Healt*

| | | Age | | Sternum. | | Second rib. | | Fourth and fifth ribs. | | Sixth rib, anterior. | | Sixth ri latei | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | upper | lower | right | left | right | left | right | left | right | le |
| Females. | 50. H. Barton | 19 | dysmenorrhœa, chest healthy | 20<br>50 | 10 | 28 | 28 | 10 | 7 | 8 | — | — | - |
| | 51. Sarah Bluson | 19 | diarrhœa, chest healthy | 18<br>70 | 16 | 25 | 20 | 25 | 16 | 15 | 15 | — | - |
| | 52. F. A. Winfield | 6 | healthy, chest healthy | 5<br>25 | 4/5<br>20 | ... | ... | ... | ... | ... | ... | — | - |
| Children, pp. 374-376. | 53. J. Drake | 2 mo. | healthy child, observed asleep, chest healthy | 2/4 | *1/ *2 | ... | 2/4 | ... | ... | ... | *1/*2<br>*3 | — | *1/ *2 |
| | 54. F. Williams | 1 mo. | healthy child, chest healthy | 2/4 | *3 | 3/6 | 4/6/10 | *1 | *1 | *4 | *3 | *3 | *4 |
| | 55. Child | 2½ y. | healthy child, chest healthy | 2/4/5 | *2/ *5 | 3/5 | 3/5 | *1 | *1 | *3/*6<br>*10 | *3/*6<br>*10 | — | *2<br>*6 |
| | 56. M. A. Scott | 2y. 8m. | in epileptic fit, chest healthy | 2/5<br>5/10 | 1/2/0 | ...<br>10/12 | 2/6<br>9 | ... | ... | ... | 2/6 | — | *1/*2 |
| | 57. Mary Wain | 2 | abdomen large, chest healthy | 4/5 | 12/20<br>cr. 20 | 5/7 | ... | 10/12 | ... | 10/15<br>cr. 20 | — | *2/2<br>*4/1<br>cr.<br>20/30 | — |

ontinued.

| Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. | | | | | | No of respirations per minute. | Breathing capacity. | height. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | above nipple | | xyphoid cartilage | | Abdomen | | | | |
| right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | | | |
| ... | ... | 4 | ... | ... | 8<br>20 | | | | | | | | | | | | |
| ... | ... | 15 | 10 | 10 | 8/12<br>60 | 7/10 | | | | | | | | | | | |
| ... | ... | ... | ... | ... | 25<br>50/60 | | | | | | | | | | | | |
| ... | *1 | ... | *3/*4 | ... | 8/10 | | | | | | | | | | | | |
| *2 | *6 | *2 | *3 | ... | 4/6 | | | | | | | | | | | | |
| *10<br>*15 | *10<br>*25 | 1/2 | 1/2 | ... | 8/15 | | | | | | | | | | | | |
| ... | 5 | ... | 4 | ... | 8/12 | | | | | | | | | | | | |
| r*20/30<br>cr†50 | ... | cr. 5/15 | ... | ... | 15/20<br>cr.<br>20/40 | | | | | | | | | | | | |

## TABLE II.—*Cases in which the Respiratory Movements were themselves being healthy,*

| | | Age | | Sternum. upper | Sternum. lower | Second rib. right | Second rib. left | Fourth and fifth ribs. right | Fourth and fifth ribs. left | Sixth rib, anterior. right | Sixth rib, anterior. left |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Motion of the ribs of both sides restrained, p. 378. | 58. W. Bulwer | 9 | posterior spinal curvature at sixth dorsal vertebra | 5 | 15 | 5 | 5/8 | 3 | 2 | 6 | 5 |
| | 59. A Youth | | ditto ditto ... | 2 | 0 | 30 | 2<br>20 | 2 | 3 | 6 | 2 |
| | 60. Clemens | | ditto at the last dorsal vertebra | 4/6<br>60 | 9<br>75 | 9<br>70 | 7<br>70 | 3<br>12 | 4<br>40 | 2<br>9 | 5/6<br>30 |
| Motion of the ribs of one side restrained, p. 379. | 61. A Girl | | lateral spinal curvature, convexity to right | 12/20 | 12 | 20/25<br>70 | 10<br>60 | 15/23<br>*9*20 | 3 | 15<br>30 | 8 |
| | 62. Wm. Beaton | 15 | ditto, lower dorsal vertebra | 6<br>60 | 5<br>40 | 10<br>70 | 9<br>70 | 5<br>30 | 3/4<br>30 | 6<br>25 | 6<br>25 |
| | 63. Rt. Severn | 16 | injury to left shoulder and cervical vertebræ | *2 †3 | *6 | 3/6 | *6 | *1 †5 | *6 | 5 | *6 |
| | 63*a*. Ditto | | second observation | 2 *2 | *2 †3 | 4/9 | *4/5 | 2 | 0 | 9 | 4 |
| | 63*b*. Ditto | | third, well ... ... | 10 | 11 | 3/12 | 3/12 | 4/8 | 12 | 10 | 4 |
| | 64. Wm. Frost | ab. 45 | erysipelas of arm ... | 8 | ... | 15<br>40/70 | 10<br>25/50 | | | | |
| | 65. John Bingham | 15 | fracture of arm ... ... | 3/8<br>60 | 5/10<br>70 | 0/3/8<br>100 | 0/2/6<br>80 | 5/10 | 3/8 | 10<br>100 | 10<br>95 |
| | 66. John Lane | 64 | erysipelatous abscess in axilla | 2/4<br>25 | 1/2<br>10 | 1½<br>10 | 3<br>10 | 0/1½ | 0/1½ | 1<br>15 | 1<br>14 |
| | 67 Mrs. Barker | 42 | schirrhous ulcer of left mamma | 6 | 6 | 8<br>35 | 6<br>25 | ... | ... | 10<br>38 | 5<br>28 |
| | 68. James Ward | 39 | old injury to second rib | ½/2<br>50 | 4/5<br>50 | 3/5<br>60 | 7/10<br>60 | 2<br>50 | 1/2<br>50 | 2/5<br>70 | 2/4<br>60 |
| | 69. Wm. Parker | 15 | abscess between left second and third costal cartilages | 3 | *4 | 8 | 4<br>8 | 4 | 0 | *1 | *3 |
| | 70. John Sketchley | | fracture of left rib, rupture of lung | *9 †4 | *7 | 2/9 | *5 †7<br>*5 †3 | 1 | *5 | *2 †3 | *7/*9 |
| | 71. Moore | | pleurodynia, near the sixth costal cartilage | 2/5/10 | 2/6 | 3/5 | 2/5 | 4 | ½/3 | 6 | 5 |
| p. 379. | 72. C. Williams | 40or50 | heart disease, left hemiplegia | 9 | 0 | 6 | 8 | 1 | 0 | 0 | 0 |
| | 73. E. Brooks | 4 | left hemiplegia | 3 | 2 | *1 †1 | *1 | 0 | 0 | *1 †1 | 0 |
| | 74. | | | | | | | | | | |
| p. 383. | 75. W. Glossop | 14 | exaggerated motion of thoracic ribs from loss of arm | 12/25 | 10/25 | 15/40 | 10/30 | 5/30 | 5/30 | 15/26 | 18/29 |
| Diaphragm restrained, p. 384. | 76. W. Barratt | 35 | acute peritonitis, more severe on left side, following operation for hernia | 10 | 5 | 16/22 | 16/22 | 8 | 6 | 8 | 6 |
| | 77. Wm. Kew | 22 | acute peritonitis ... | 15 | 4 | 20 | 30 | 8 | 12 | 6 | 6 |
| | 78. Eliz. Hussey | 55 | acute peritonitis ... | 20 | 5 | 33 | 40 | 10 | 10 | 7 | 8 |

*disturbed, rendered abnormal, or abnormally changed, the Lungs* pp. 378-393.

| Sixth rib, lateral, | | Eighth rib. | | Tenth rib, | | Abdominal, | | | Rhythm, | | Tape measurements, above nipple | | xyphoid cartilage | | Abdomen, | | No. of respirations per minute. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | |
| 3 | 4 | 10 | 12 | 15 | 7 | 18 | 20 | 18 | | | | | | | | | |
| ... | ... | ... | ... | 2 | 1 | 10 | 50 | 7 | | | | | | | | | |
| ... | ... | ... | ... | 2 | 5 | 4 | 5 | 2 | ... | ... | 17 5 | 17·5 | 15·4 | 15·2 | | | |
| ... | ... | ... | ... | 15 | 3 | 15 | 35 | 3 | ... | ... | ... | ... | 13·1 | 13 | | | |
| 6<br>20 | 2<br>20 | 8<br>50 | 8<br>50 | 6<br>35 | 8<br>15 | 7 | 20<br>90 | 4 | | | | | | | | | |
| ... | ... | ... | ... | 11 | 10 | 16 | ... | 12 | ... | ... | 14 | 14 | | | | | |
| ... | ... | ... | ... | 6 | 4 | ... | 16<br>60 | | | | | | | | | | |
| ... | ... | ... | ... | 15/20 | 8 | 20 | 50 | 12 | ... | ... | 14 | 14 | 13·4 | 13·2 | | | |
| 8/14 | 8/14 | 10<br>90 | 9<br>75 | 12<br>80 | 10<br>70 | 7<br>30 | 45<br>70 | 5<br>30 | 3 | 4 | 16<br>15·7 | 16<br>16·7 | 15·4 | 15 6 | 13 7 | 14 | |
| 3/6<br>15 | *1 †1<br>15 | 4/5<br>*1 †3 | 2<br>*10 | 4/5 | 1/2 | 3 | 25/40<br>70 | 3 | 8 | 8 | 16·9<br>17·2 | 16·9<br>17·2 | 17·2 | 17·2 | 14·9 | 15·2 | 20 |
| 7 | 1 | 10 | 5 | 11 | 9 | 8 | 18 | 10 | 4 | 4 | | | | | | | |
| 2/3<br>40 | 1/2<br>40 | 4/5<br>32 | 4/5<br>18 | 4/5<br>22 | 3/9<br>25 | 5<br>0/22 | 23/30<br>100 | 11<br>20/22 | 5 | 5 | 16·7<br>17·3<br>18·1 | 16·4<br>17·1<br>17 9 | 17·3 | 16 9 | 13 8 | 13 8 | 22 |
| ... | ... | ... | ... | 9 | 6 | 18 | 25<br>40 | 18 | | | | | | | | | |
| *1†3/5 | *8 | 20 | *5 | 8/11 | 3/7 | 22/30 | 37 | 10/15 | 5 | 10 | ... | ... | ... | ... | ... | ... | 22 |
| ... | ... | ... | ... | 8 | 10 | 10 | 35 | 8 | 6 | 6 | 17 | 17 | 15·6 | 15·3 | | | |
| ... | ... | ... | ... | 5 | 3 | 5 | 25 | 3 | 6 | 7 | | | | | | | |
| ... | ... | ... | ... | 5 | 2 | 5 | 14 | | | | | | | | | | |
| 16/25 | 12/20 | 10/20 | 10/20 | 3/7 | 3/7 | 10/15 | 60/90 | 6/12 | 6 | 6 | 12·3 | 12·3 | 12 | 12 | ... | ... | 23 |
| ... | ... | ... | ... | 6 | 6 | 2 | 1/5 | 0 | 5 | 3 | | | | | | | |
| ... | ... | ... | ... | 5 | 3 | 7 | 6 | 8 | | | | | | | | | |
| ... | ... | ... | ... | 2 | 2 | 7 | 3 | 6 | | | | | | | | | |

TABLE II.—

| | | Age | | Sternum. | | Second rib. | | Fourth and fifth ribs. | | Sixth rib, asterior. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | upper | lower | right | left | right | left | right | left |
| Diaphragm restrained, p. 384. | 79. Wm. Severn | 30 | chronic peritonitis ... | 13<br>10 | 5 | 10 | 10 | 5 | 3 | ... | 5 |
| | 80. Ch. Osborne | 40 | local peritonitis over caput cæcum coli ... | 10/15 | rises very irreg. | 12/25 | 15/25 | 10 | 5/10 | 8 | 12 |
| | 81. Geo. Simpson | 43 | tumour in abdomen ... | 10<br>50 | 5 | 8 | 7 | 6 | 3 | 7 | 5 |
| | 82. Wm. St. | | enlarged liver, hydatids? | 10 | 2/4 | 10<br>40 | 25<br>70 | 1 | 4 | 0 | *2 †4 |
| | 83. John Barton | 32 | adherent liver ... ... | 10<br>45 | 4<br>80 | 19<br>25 | 30<br>60 | 4<br>15 | 30<br>40 | 6<br>13 | 10<br>30 |
| | 84. N. Stones | 69 | adherent liver? | 7/9<br>30 | 4<br>12 | 5/6<br>40 | 5/6<br>40/50 | 0/2<br>*3 †3 | 0/2<br>28 | 0/3<br>5 | 1/4<br>25 |
| | 85. J. Clarke | 15 | intestinal and gastric distention | 6<br>50 | 5<br>50 | 8/9<br>110 | 8/9<br>100 | 8<br>90 | 4/5<br>70 | 10<br>60 | 5<br>45 |
| p. 392. | 86. Mrs. Koe | 35 | pregnant ... ... | 5<br>50 | 3 | 5 | 6 | ... | ... | 2/4 | 2 |
| | 87. Mrs. Sands | 30 | pregnant ... ... | 4<br>30 | 3½ | 5 | 5 | ... | ... | 3 | 5 |

continued.

| Sixth rib, lateral. | | Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. above nipple | | xyphoid cartilage | | Abdomen. | | No. of respirations per minute |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | |
| ... | ... | ... | ... | 5 | 5 | 10 | 13<br>35 | 10 | | | | | | | | | |
| ... | ... | ... | ... | 12 | 10 | 6/8 | 10/15 | 15 | | | | | | | | | |
| ... | ... | ... | ... | 5 | 5 | 10 | 15<br>70 | 10 | | | | | | | | | |
| ... | ... | ... | ... | *2½ | 5 | 10 | 25 | 10 | | | | | | | | | |
| 6 | 12 | 8 | 20 | 7 | 16 | 18 | *2 †10 | 25 | 4 | 5 | 15 | 15 | 16·6 | 15·5 | 14·2 | 14·2 | |
| 10 | 20 | 8 | 20 | 20 | 20 | 40 | 50 | 40 | | | 15·2 | 16·3 | 16 6 | 16 | 14·8 | 15·2 | |
| 0 | 5 | 2<br>6 | 5<br>10 | 4/5<br>†1 *3 | 6/7<br>14 | 4/7<br>20 | 30<br>70 | 2/4<br>10 | 6 | 9 | 14 9<br>15·8 | 14 9<br>15·2 | 15·6 | 15·6 | 15·9 | 15·1 | 18 |
| 9 | 5 | 13 | 10 | 12 | 10 | 15 | 20 | 10 | 4 | 6 | 12·5 | 12·4 | 12·6 | 1 2 | 12 3 | 12·5 | 18 |
| 60 | 40 | 55 | 45 | 50 | 40 | 30 | 50 | 30 | | | 13 5 | 13·4 | | | | | |
| 5 | 4 | ... | ... | 6/7/8 | 6 | 4 | 8 | 6/8 | | | | | | | | | |
| 2 | ½/1 | 7<br>30 | 2<br>6 | 4 | 1 | 10 | 10<br>50 | 6 | 4 | 4 | 15 | 15 | 13 | 13 | ... | ... | 20 |

TABLE III.—*Cases in which the Respiratory Movements were disturbed, Respiratory Organs,*

| | | Age | | Sternum. upper | Sternum. lower | Second rib. right | Second rib. left | Fourth and fifth ribs. right | Fourth and fifth ribs. left | Sixth rib, anterior. right | Sixth rib, anterior. left |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Obstruction to respiration in outer air-passages, p. 393-402. | 88. Josiah Chester | 13 | enlarged tonsils, scarlatina | 20/*6†10 | *14/*20 | 30 | 25 | 15 | 15 | *10 | 15 |
| | 89. T. Maltby | 21 | bronchocele ... ... | *3 †½ *20 †60 | *4 *10 †30 | *3 †1 | *2 *10†70 | *3 | *3 | *3 | *3 |
| | 90. Jeh. Mann | 23 | bronchocele ... ... | *2 †5 | *1 †5 | 5 | *1 †6 | *3 | *2 †3 | *3 | *3 |
| | 91. Alf. Scattergood | 16 | enlarged tonsils, laryngitis | 8/15 | *4 †7 50 | 10 100 | 8 70 | 10 | 5/8 60 | 10/15 60 | *1 †6 60 |
| | 92. — Robinson | 25 | obstructed nostrils and fauces | *2 †1 30 | *6 †10 *4 | 10 | *1 †6 | *1 †2 | *3 | *1 †5 | *2 |
| | 93. Ann Slater | 27 | lacerated larynx or trachea | *6/40 | *2/*30 | 6/60 | 2/40 | 2/4 | 4 | 2/30 | 2 |
| | 94. Mrs. Meads | 27 | chronic laryngitis ... | *1 †4 | *4 | 5 | 5 | ... | ... | *2 †2 | *2 †2 |
| Obstruction to respiration in the smaller bronchi, p. 402. | 95. Jos. Squire | 30 | emphysema and bronchitis | 20/30 110 | *12 16 *30 | 25/26 | 22/25 | 22/25 | 22/25 | *6 †24 | *10†2 |
| | 96*a*. W. Rawson | 13 | emphysema and bronchitis | 4/10 30 | *3/*6 | 6/11 | 12 | *2 †5 | *1 †3 | *7 | *5 |
| | 96*b*. Do. 1 month afterwards | | emphysema and bronchitis, improving | 3/10 50 | *8 *8 †20 | 3/12 | 15 | 3/9 | 11 | *10 | *3 †2 |
| | 97. Geo. Simpson | 50 | bronchitis ... ... | 4 50 | *5 | 9/12 30 | 9/8 30 | *3 | *3 | *2 †3 | *4 |
| Cases of males, in which the lower end of the sternum receded, p. 403. | 98*a*. W. Galloway | 40 | emphysema, heart disease &c. | 6 | *3 | 12 | 14 | 3 | *1 †4 | *3 †1 | *3 †6 *3 |
| | 98*b*. Ditto, second observation | | worse ... ... ... | 4/10 | *4/*15 cough *20 | 8 | 12 | *2 †2 | *3 †2 †2 *2 | *2 †4 | *4 †4 |
| | 99. J. Hart | 32 | emphysema and bronchitis | 2/6 | *1/*4 sometimes *1 †5 | 2/9 70 | 3/12 60 | 1/3 20 | 3/9 30 | 5 | 5 70 |
| | 100. J. Linthwaite | 50 | emphysema and bronchitis | 9/24 40 | *2 †8 *2 †20 | 10/25 50 | 10/25 40 | 8/12 | 6/10 | *1 †10 *1 †20 | *2 †5 *2 †17 |
| | 101. W. Redmill | 46 | emphysema ... ... | 5 25 | *2 *3 †20 | 7 35 | 4 30 | 3 | 0 | 2 | 3 |
| | 102. J. Worth | 30 | emphysema and bronchitis | 3/5 70 | *½ †3 *2 †60 | 2/5 110 | 2/10 110 | 1 80 | 0/5 80 | 3 60 | 4/12 80 |
| | 103. G. Rogers | 41 | emphysema and bronchitis | 4/8 | *2 †4 | *2 †4 | 6 | *2 †2 30 | *1 †4 30 | *3 †4 | *2 †3 |
| | 104. J. Shaw | 45 | bronchitis and emphysema | 12/20 55 | 10/12 †3 *12 30 | 10/15 90 | 10/15 80 | 12 | *3 †7 | 15 | 12 |
| | 105. Hugh James | 25 | bronchitis, not severe ... | 8 | 6 | 6 | 9 | 5 | 12 | 6 | 7 |
| | 106. J. Clews | 30 | bronchitis, not severe ... | 4 | 5 | 4 | 4 | 0 | 5 | 3 | 6 |
| | 107. J. Eaton | 40 | bronchitis, not severe ... | 5 | 5 | 5/6 | 4/7 | 3/5 | 1/8 | 6 | 3 |

*rendered abnormal, or abnormally changed, by Diseases in the* pp. 393-460.

| Sixth rib, lateral. | | Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. above nipple. | | xyphoid cartilage | | Abdomen. | | No. of respirations per minute. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | |
| ... | ... | ... | ... | 12 | 15 | 18 | 0 | 25 | | | | | | | | | |
| ... | ... | ... | ... | 7 | 6 | 18 | 30<br>100 | 10 | 5 | 8 | 16 | 15 | 14·5 | 14 | ... | ... | 28 |
| ... | ... | ... | ... | 10 | 9 | ... | 30<br>60 | 3 | ... | ... | 11·2 | 11·2 | ... | ... | ... | ... | 24 |
| ... | ... | ... | ... | 10/15 | 10 | 12 | 12<br>100 | 6 | | | | | | | | | |
| ... | ... | ... | ... | 10 | 9 | 5 | 15<br>20 | 10 | 6 | 10 | ... | ... | ... | ... | ... | ... | 25 |
| ... | ... | ... | ... | ... | ... | 2/20 | 6/40 | 2/20 | | | | | | | | | |
| 4 | 3 | 7 | 7 | 11 | 12 | 10 | 20 | 10 | 3 | 3 | 14 | 14 | 13·6 | 13·4 | | | |
| ... | ... | ... | ... | 20 | ... | 12 | 30/50 | 12 | 4 | 6 | | | | | | | |
| 4/12 | 5 | ... | ... | ... | ... | 10 | 12/18 | ... | 3 | 8 | | | | | | | |
| ... | ... | ... | ... | 10 | 12 | 10 | 35<br>50 | ... | 6 | 9 | | | | | | | |
| ... | ... | ... | ... | 10 | 6 | 10 | 25 | 10 | | | | | | | | | |
| *1 †1 | *1 †4 | *3 | 10 *7 | 3 | 3 | 3 | 20 | 12 | 4 | 8 | ... | ... | 15·5 | 15·5 | ... | ... | 28 |
| 3/8 | 4/9 | 0/*2/5 | *5 †3 | 1/2 | ½ | 6 | 20 | 5 | 4 | 12 | 16·5 | 16·5 | 16·8 | 16·8 | 16·6 | 16·8 | 28 |
| 3/5 | 2 | 10 | 6 | 4/6 | 4 | 8 | 18 | 9 | 4 | 8 | ... | ... | ... | ... | ... | ... | 20 |
| 8/16<br>30 | 6/14<br>15 | 12 | 10 | 0/20 | 10/20 | 7/15 | 10/50<br>70 | 7/15 | 4/8 | 9/16 | 16·2 | 16 | 17 | 16·4 | 14·8 | 14·8 | 19 |
| ... | ... | ... | ... | 10 | 10 | 18 | 30<br>50 | 15 | | | | | | | | | |
| ... | ... | ... | ... | 3<br>40 | 3/10<br>50 | ... | 25/35<br>70 | ... | 5 | 9 | 16 | 16 | 14·6<br>15·6 | 14·8<br>15·9 | ... | ... | 36 |
| ... | ... | ... | ... | 6 | 5 | 8 | 40 | 12 | 5<br>abdo | 9<br>minal | 18·3 | 18·6 | 17·5 | 17·3 | | | |
| 5<br>35 | 4<br>40 | 10<br>45 | 10<br>40 | 8/10<br>25 | 8/10<br>20 | 2/3 | *5 †23<br>80 | 2/3 | ... | ... | ... | 13 | 15·5<br>16·5 | 15<br>15·5 | 14·2 | 14·2 | 22 |
| ... | ... | 6 | 6 | 7 | 10 | 10 | 30 | 15 | 5 | 8 | 17·6 | 16·7 | 17 | 16·3 | | | |
| 8 | ... | ... | ... | 8 | 10/12 | 3 | 40/50 | 35 | 4 | 6 | 17·3 | 17·5 | 17·8 | 16·5 | ... | ... | 21 |
| 4/6 | 2/5 | 4 | 2/5 | 9 | 6 | 8 | 20/35 | 15/30 | 4 | 4 | 15·8 | 15·8 | 15·8 | 15·8 | | | |

TABLE III.

Obstruction to respiration in the smaller bronchial tubes.

| | | Age | | Sternum. | | Second rib. | | Fourth and fifth ribs. | | Sixth ribs. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | upper | lower | right | left | right | left | right | left |
| Cases in old men, p. 410. | 108. W. Shaw | 30 | emphysema and bronchitis | 8 | 4<br>23 | 10/15<br>25 | 8/15<br>25 | 4 | 6 | *3 | *1 |
| | 109. J. Eyre | 75 | emphysema ... ... | *2 †6 | 6 | *1 †5 | *1 †2 | *1 †3 | *2 †2 | 7 | 1 |
| | 110. W. Flinders | 69 | emphysema ... ... | 8 | 9 | 4 | 7/10 | 6/7 | 5/10 | 7 | 4 |
| | 111. T. Thompson | 60 | emphysema ... ... | 6 | *2/6<br>13 | 7/8 | 10 | 3 | ... | *1/2 | *2 |
| | 112. J. Newman | 58 | emphysema ... ... | 5<br>*5 †30 | 1/2<br>*2 †60 | 4<br>40 | 5<br>*4 †30 | *3<br>*5 †40 | 2 | *11<br>*12†20 | *1<br>*4 |
| Cases in females, p. 420. | 113. M. Cross | 14 | bronchitis ... ... | 5<br>6 | *2<br>*2 †6 | 3/5<br>14 | 3/5<br>12 | *1/*½ | *1/*½ | *½/*1<br>*3/8*2 | *1/*<br>2/* |
| | 114. Sarah Chamberlain | 20 | bronchitis left lung ... | 25 | *2 †8 | 10/12 | 10/12 | 10 | 10 | 7 | 8 |
| | 115. J. Elliott | 52 | bronchitis and emphysema | 15 | *6 | 12 | 15 | ... | ... | *2 †6 | *2 † |
| | 116. Mrs. Cooper | 30 | bronchitis and emphysema | 12 | 20 | 20 | 12/20 | *3 †9 | *3 †4<br>*2 | *8 | *10<br>*2 |
| | 117. Mrs. Barker | 32 | bronchitis and emphysema | 3/15 | *2/*4 | 4 | 4 | 0 | 0 | 1 | 0 |
| | 118. Lilly Waud | 20 | bronchitis, left side ... | 6/10 | *3 | 10/15 | 10/15 | ... | *2 †2 | 3 | *3 |
| | 119. S. Henson | 70 | bronchitis and emphysema | 15 | 9 | 25 | 20 | ... | ... | 6 | 8 |
| | 120. Mary Smith | | ... ... ... ... | 5 | *6 | 6 | 6 | ... | ... | *2 | *3 |
| Cases in children, p. 421. | 121. W. Langsdale | 4 | bronchitis ... ... | 3/10 | *5/*10 | 5/12 | 5/12 | 0/3 | 0/3 | *4/ *6 | *3, *3 |
| | 122. E. Brown | 2 | bronchitis ... ... | 5 | *2 | 7 | 7 | 3 | 1 | *3 | *3 |
| | 123. M. Miller | 2 | bronchitis ... ... | 4/12 | ... | 6/13 | 6/14 | 0 | 0 | *2 /4 | *2 /4 |
| | 124. T. Smith | 6 mo. | bronchitis ... ... | 1/5 | *1/*8 | *10/ *15 | *10/ *15 | ... | ... | *1/ *3 | 0 |
| | 125. John Lowe | 4 | bronchitis ... ... | 8/18 | 6 | 3/6 | 5/12 | ... | ... | *1/ *2 | *2 |
| | 126. S. Garton | 7 mo. | bronchitis ... ... | 14/20 | 10 | (?) | 6 | (?) | 0 | 10 | 6 |
| | 127. Geo Garner | 10 w. | bronchitis ... ... | 3/20 | 0/5 | ... | ... | ... | ... | ... | ... |
| | 128. Eliz. Walker | 3 | hooping-cough ... ... | 9 | *1 †4 | 8/12 | 8/12 | *2 | *1 | *3 | *4 |

**continued.**

| Sixth rib, lateral. | | Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. above nipple | | xyphoid cartilage | | Abdomen. | | No. of respirations per minute. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | |
| *1 | *1 †1 | *8 *5 †5 | *7 *5 †5 | 1 *3 | 3 | 12 | 45 | 10 | 4 | 9 | 16 | 16 | 15·6 | 15.5 | | | |
| 0 | 0 | 4 | 4 | 4 | 4/6 | 10 | 35 | 12 | 4 | 8 | 17·2 | 18 | 18 | 18·4 | | | |
| 2 | 4 | 6 | 12 | 16 15 | 13 | 20 | 60 | 15 | 6 | 9 | 17·4 | 17·2 | 16 | 15·6 | | | |
| 6 | *2 †3 | *2 †6 *10 | *3 †6 *12 | *2 | *4 | ... | 10 | ... | 4 | 8 | 18·5 | 18·5 | 18·5 | 18 | | | |
| ... | ... | ... | ... | 4 | 6 | 20 | 60 | 20 | | | | | | | | | |
| ½/1 | 1/2 | 3 | 2 | 3/5 | 2/5 | 4 | 15 50 | 4 | 4 | 6 | 13·2 13·6 | 12·6 12·8 | 12·6 | 12·5 | 11·5 | 11·7 | 42 |
| ... | ... | ... | ... | 6 | 15 | 20 | 50 | 10 | | | | | | | | | |
| 4 | 4 | 6 | ... | 10 | 2 | 5 | 2/6 | 4 | 4 | 7 | 15·5 | 15·5 | 13·5 | 13·5 | ... | ... | 32 |
| *4 †2/6 | *10 | *6 †8 | *12 | 15 | 8/*2 | 30 | 40 | 20 | ... | ... | 14 | 13·8 | 12·8 12·7 | 12·8 12·6 | | | |
| ... | ... | ... | ... | 5 | 6 | 4 | 15 | 7 | | | | | | | | | |
| ... | ... | ... | ... | 8 | 8 | ... | 6/12 | | | | | | | | | | |
| 4 | 4 | 15 | 15 | 15 | 18 | 15 | 15 | 12 | 4 | 6 | 14·5 | 14 | 12·7 | 12·5 | | | |
| 10 | 12 | ... | ... | 10 | 12 | 4 | 12 | 10 | | | | | | | | | |
| *6 | *3 | *5/*11 | *4/ *6 | 10 | 3/6 | 5 | 16/20 | 17 | 3 | 2 | 9·5 | 9·5 | 9·1 9·3 | 9·1 9·3 | | | |
| ... | ... | ... | ... | ... | 4 | ... | 12 | | | | | | | | | | |
| irreg. | ... | ... | ... | ... | ... | 10 | 10/15 | †5/15 | | | | | | | | | |
| *3 | *1 | ... | ... | ... | ... | ... | 10 | | | | | | | | | | |
| *1/*1†3 | *3 | 10 | *2 †3 | 7 | 2/5 | 7 | 10 | 6 | ... | ... | 9 | 9 | 9·8 | 9·8 | | | |
| ... | ... | ... | ... | ... | 6 | | | | | | | | | | | | |
| ... | ... | ... | *1/*10 | ... | ... | ... | ... | 2 | | | | | | | | | |
| ... | ... | ... | ... | 6 | 6 | ... | 10/20 | ... | ... | ... | ... | ... | ... | ... | ... | --- | --- 60 |

TABLE III.

| | | Age | | Sternum. upper | Sternum. lower | Second rib. right | Second rib. left | Fourth and fifth ribs. right | Fourth and fifth ribs. left | Sixth rib, anterior. right | Sixth rib, anterior. left |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Diseases of one lung, or one side of the chest, p. 426. | Obstruction in smaller bronchi—children. | 129. Child | 2 | bronchitis ... ... | 10 | *3/ *4 | 7 | 10 | *2 | *2 | *2 | *1 |
| | | 130. E. Smith | 18 mo. | hooping-cough ... ... | 3/10 | *2 †4 | 4/14 | 3/8 | *2 | *4 | *10 | *12 |
| | | 131. Child ... ... | | hooping-cough ... ... | 15 | *5/ *6 | ... | ... | ... | ... | *15 | *15 |
| | | 132. Child ... ... | | hooping-cough ... ... | 10 | 4 | 12 | 12 | *2 | 7 | *6 | *6 |
| | Pleuritis, p. 426. | 133. Sarah Simpkin | | pleuritis, lower lobe of left lung | 10 | 11 | 11 | 8 | ... | ... | 7 | 7 |
| | | 134a. Jane Shepherd, 7, second observation, p. 426 | | pleuritis, lower lobe of right lung | 5 | *3 | 10 | 10 | 4 | 3 | *3/ *4 | *3 |
| | | 135. James Brown | | effusion into right pleural cavity | 3 | 4 | 5 | 10 | 2<br>40 | 3<br>70 | 3 | 4 |
| | | 136. L. Davis | | effusion into right cavity | 10 | *4 | 18 | 17 | *1 †2 | *1 †1 | *1 | *2 †1 |
| | Effusion into pleura, p. 428. | 137. W. Webb | 15 | effusion into left cavity | 8 | *1 †4 | 12 | 5 | 8 | 0 | 6 | *2 †1 |
| | | 138. M. Roach, patient of Dr. Walshe | | effusion into left cavity | 12 | *2 †4 | 5<br>20 | 0<br>12 | 12 | 0 | 8 | *3 †3 |
| | | 139a. Ts. Cooke | 8 | effusion into left cavity | 2 | 3 | 8/12 | 0 | 5/8 | *1 | *1 †4 | 0 |
| | | 139b. Ditto, second servation | | condensation of left lung | *2 | *4 | 8/12 | 0 | 8/10 | 0 | 8 | *2 |
| | Condensation of one lung, p. 434. | 139c. Ditto, third observation | | condensation of left lung | 2<br>45 | *2/ *6<br>20 | 8/12<br>60 | 0<br>20 | 5<br>30 | *1<br>12 | *2 †2<br>40 | *3<br>30 |
| | | 140. Barb. Beasley patient of Dr. Theo. Thompson | 7 | condensation of left lung following effusion | 0 | ... | 1 | *2 †2 | 5 | 0 | 7 | 0 |
| | Phthisis affecting the whole of one lung, p. 438. | 141a. Th. Neale | 51 | tuberculous disease of the whole of the left lung, cavity in upper lobe | *3 | *4 | 11 | *2 | 6 | *2 | 8 | *4 |
| | | 141b. Ditto, second observation | | ditto ... ... | *12 | *12 | 12 | *3 | 8 | *2 | 12 | *12 |
| | | 141c. Ditto, third observation, in articulo | | ditto ... ... | *2 †2 | *4 | 15 | *1 †3 | 20 | *3 | 118 | *3 |
| | | 142. Mrs. Kirk | 42 | ditto ... ... | 10/20 | 14 | 20<br>70 | 10/14<br>40 | 8 | *1<br>*2 †1 | 14/1<br>60 | *1 †6<br>30 |
| | | 143. M. A. Elliott | 18 | ditto ... ... | 4 | *2 †2 | 5/10<br>38 | 4<br>30 | ... | ... | 4 | 3 |
| | | 144. Wm Osborn | 46 | ditto ... ... | *1 †5 | *4 | 10/12<br>35 | *1 †8<br>35 | 6 | *1 †3 | 8 | *3 †1 |
| | | 145. D. Harley | 41 | ditto ... ... | *1 †1 | 11 | 8<br>15 | 0<br>5 | *2 †5 | *3 †4 | 12<br>40 | *1 †2<br>10 |
| | | 146. J. Wood | 37 | ditto ... ... | *1 †5 | 7/6 | 8/14<br>90 | 4<br>40 | 5 | 0 | 12 | *1/0 |
| | | 147. J. W. Porter | 60 | ditto ... ... | 14 | 10 | 8<br>30 | 5<br>0 | 3 | *1 †2 | 8<br>30 | *4<br>†4 |

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| Sixth rib, lateral. | | Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. above nipple | | xyphoid cartilage | | Abdomen. | | No. of respirations per minute. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | |
| ... | ... | ... | ... | ... | 4 | | | | | | | | | | | | |
| ... | ... | ... | ... | *2 | *3 | ... | 25 | | | | | | | | | | |
| ... | ... | ... | ... | ... | ... | ... | 15 | | | | | | | | | | |
| ... | ... | ... | ... | 4 | 3 | ... | 6 | | | | | | | | | | |
| 3 | *½ | 8 | 10 | 13 | 10 | 17 | 10 | 13 | ... | ... | ... | ... | ... | ... | ... | ... | 24 |
| 3 | 3 | 8 | 8 | 8 | 8 | 6 | 15 | 8 | 4 | 6 | ... | ... | ... | ... | ... | ... | 52 |
| ... | ... | ... | ... | 5 | 10 | 10 | 36 | 16 | 6 | 7 | | | | | | | |
| ... | ... | ... | ... | 3 | 6 | 12 | *3 | 6 | | | | | | | | | |
| ... | ... | ... | ... | 10 | 2 | 10 | 12 | 6 | 5 | 8 | | | | | | | |
| ... | ... | ... | ... | 12 | 2/3 | | | | | | | | | | | | |
| ... | ... | ... | ... | 5 | 1 | 6 | 15 | 3 | ... | ... | 10·4 | 10·1 | 10·7 | 11·2 | ... | ... | 60 |
| ... | ... | ... | ... | 8 | 0 | 12 | 22 | 3 | | | | | | | | | |
| 2/5 | *1 *3 | 5 | 0/½/1 | 3/6 | 0/½/1 | 10/20 | 15/20 | 5/10 | 6 | 7 | 11·5<br>12 | 11·1<br>11·2 | 11·5<br>12·3 | 11·1<br>11·2 | 11·3 | 11·3 | 20 |
| 40 | 16 | 35 | 20 | 20 | 5 | | 30 | | | | 12·3 | 11·3 | 12·7 | 11·3 | | | |
| ... | ... | ... | ... | 5 | 0 | 8 | 15 | 0 | ... | ... | 10·7 | 9·5 | | | | | |
| ... | ... | ... | ... | 16 | 10 | 22 | 25 | 6 | | | | | | | | | |
| ... | ... | ... | ... | 25 | 7 | 20 | 12/20 | 12 | | | | | | | | | |
| ... | ... | ... | ... | 16 | 8 | 25 | 15/20 | 14 | | | | | | | | | |
| ... | ... | ... | ... | 7/10<br>70 | 6<br>30 | 10 | 25<br>100 | 12<br>10 | | | | | | | | | |
| 6 | 4 | 8 | 10 | 7 | 8 | 7 | 12 | 8 | 4 | 7 | 13 | 12·5 | | | | | |
| ... | ... | ... | ... | 15 | 10 | 10 | 20 | 4 | 5 | 8 | 17⅘ | 16⅘ | 17⅗ | 16⅗ | | | |
| ... | ... | ... | ... | 15 | 9 | 18 | 15<br>60 | 1 | ... | ... | 15·5 | 14·5 | 15 | 13·4 | | | |
| ... | ... | ... | ... | 15 | 5 | 15 | 30<br>70 | 5 | ... | ... | 17·4 | 16·4 | 16·9 | 15 | | | |
| ... | ... | ... | ... | 9 | 4 | 9 | 25 | 4 | ... | ... | ... | ... | 16 | 16 | | | |

TABLE II.

| | | Age | | Sternum. upper | Sternum. lower | Second rib. right | Second rib. left | Fourth and fifth ribs. right | Fourth and fifth ribs. left | |
|---|---|---|---|---|---|---|---|---|---|---|
| Diseases confined to one lung. | Phthisis of the whole of one lung. | 148. Pearson | 17 | tuberculous disease of the whole left lung, cavity in upper lobe | 13 | 10 | 17/20 | 8/10 †4 *12 | 15/20 | 6 †2 *8 | 15 |
| | | 149. R. Shitlin | | ditto ... ... | *6 | *4 | *1 †5 | *4 †1 *3 †2 | 4/*1†4 | *1 | *5 |
| | | 150. Joel Boot | 39 | tuberculous disease of the whole right lung, cavity in the upper lobe | *1 †6 | *10 | 6 | 10 | *4 | *3 | *5 |
| | | 151. M. A. | | ditto ... ... | 5/10 | 5 | 2 | 10/30 | 3 | 3/15 | 2 |
| | | 152. Mary Robinson | | ditto ... ... | 3/6 | 5/6 | 2/4 10 | 10/12 50 | 1/3 | 7/12 | 2/3 |
| | | 153. Wm. Warren | 19 | ditto ... ... | 3 | 4/6 | 2 | 3 | 0/4 | 0 | 1 2 |
| | Phthisical cavity in the upper lobe of one lung, p. 444. | 154. John Green | 27 | phthisical cavity in the left upper lobe, lower lobe not notably affected | *1 †2 | 4 *2 †45 | 3/7 85 | 0 45 | 3 80 | *2 50 | 3 85 |
| | | 155. T. Astell | 29 | ditto ... ... | 2 | *2 | 0/1 100 | 0 70 | 3 90 | *2 75 | 6 100 |
| | | 156. James Meads | 55 | ditto ... ... | 5 | 6 *8 †8 | 8 30 | 4 8 | 8 20 | 4 6 | 8 26 |
| | | 157. Rd. Alvey | 30 | ditto ... ... | 10 | 9 | 12/16 85 | 5/8 40 | 12 85 | 5 40 | 8 |
| | | 158. Henry Trout | 20 | ditto ... ... | 5 | 3 | 7 80 | 2/5 40 | 5 70 | 2/3 50 | 4 |
| | | 159. John Smith | 48 | ditto ... ... | *3 †3 | *4 | 12 35 | 5 20 | 4 | 0 | 5 |
| | | 160a. Ann Durow | 15 | ditto ... ... | 4 | *1 | 6/12 | 6 | *1 †2 | *2 †2 | 3 |
| | | 160b. Ditto, second observation | | ditto ... ... | 4/6 | 1 | 8/14 35 | 4/7 15 | 6 | *3 | 1 |
| | | 161. Jas. Parsons | 22 | ditto ... ... | 25 | *1 | 27/30 100 | 12/20 70 | 10 | 4/8 | 10 |
| | | 162. Rt. Stanyard | 36 | ditto ... ... | 8/10 | 7 | 8/11 | 6/8 | 6 | *1 †1 | 9 |
| | | 163. Sam. Redgate | 37 | ditto ... ... | *1 †2/ *2 †3 *2 †20 | *2 †5 *2 †25 | 6/10 50 | 3/7 30 | 13 55 | *2†2/7 30 | 8 34 |
| | | 164. Walt. Cavers | 18 | ditto ... ... | *1 †3/15 | *3 †4/*1 †13 | 4/5 | *2†2/3 | 1/4 | *2 †3 | *1†5/6 |
| | | 165. M. Castle | 12 | ditto ... ... | 13 | 6 | 12/16 35 | 8/13 20 | 4/5 | *2 †3 | 5/6 |
| | | 166. Ts. Rudland | 13 | ditto ... ... | 10 | *1 †4 | 10 30 | 5 16 | 0 | *1/3 | *2 †2 |
| | | 167. Ts. Coates | | ditto ... ... | *1 †4 | *3 | †8 70 | *1 †5 55 | 0 | *8/11 | *9 |

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| Sixth rib. lateral. | | Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. | | | | | | No. of respirations per minute. | breathing capacity. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | above nipple | | xyphoid cartilage | | Abdomen. | | | |
| right | left | right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | | |
| 2/16 | 8 | 25 | 22 | 15/20 | 15<br>†*10 †10 | 10 | *6 cr. 0<br>†10 *4<br>cr. †8 *8 | 10 | | | | | | | | | | |
| ... | ... | ... | ... | 18 | 12 | 25 | 25 | 18 | 5 | 5 | 15·5 | 15·6 | 15·6 | 15·2 | | | | |
| ... | ... | ... | ... | 14 | 15 | 5 | 15 | 20 | ... | ... | ... | ... | ... | 4/5 | | | | |
| 1 | 10/18 | 2 | 15 | 4 | 15 | 13 | 10/30 | 20 | 3 | 3 | | | | | | | | |
| 1/1½ | 10 | 2/3 | 9/10 | 2/4 | 10/15 | 4/7 | 10/15<br>50 | 10/15 | ... | ... | 11·6 | 12·5 | 11·2 | 12·4 | 10·5 | 11·5 | | |
| ... | ... | ... | ... | 2 | 4 | 3/5 | 30 | 3 | 14·6 | 15·5 | 15 | 15 | | | | | | |
| ... | ... | ... | ... | 6/7 | 6 | 10 | 30<br>70 | 6 | ... | ... | 17·5<br>18·2 | 17·3<br>17·7 | 16·7<br>17·7 | 16·9<br>17·5 | ... | ... | 24 | |
| ... | ... | ... | ... | 9<br>70 | 10<br>50 | 30 | 35<br>150 | | | | | | | | | | | |
| 3/6<br>12 | 3 | 14<br>30 | 9 | 1 | 7 | 15/23 | 35<br>40 | 15 | ... | ... | 15 | 14·2 | 14·2 | 14·5 | ... | ... | 32 | |
| 9 | 5/6<br>30 | 8 | 10 | 13 | 7 | 10 | 30 | 10 | | | | | | | | | | |
| 4 | 2 | 12 | 7 | 13 | 8 | 17 | 34 | 10 | 7 | 9 | 16·6 | 15·5 | 16 | 15·3 | | | | |
| ... | ... | ... | ... | 9 | 8 | 22 | 28<br>40 | 20 | | | | | | | | | | |
| ... | ... | ... | ... | 8/14 | 10 | 20/25 | 25/35 | 10/20 | ... | ... | 12·5 | 12·5 | | | | | | |
| ... | ... | ... | ... | 5 | 9 | 9 | 18<br>30 | 5 | ... | ... | eq. | eq. | | | | | | |
| ... | ... | ... | ... | 20 | 15 | 20 | 40 | 12 | | | | | | | | | | |
| 7 | 3 | 18 | 8 | 15 | 14 | 13/15 | 35 | 8 | ... | ... | 16·8<br>18·2 | 16·4<br>16·9 | 15·5 | 15·2 | ... | ... | ... | 246 |
| 7/9<br>50 | 3/5<br>*5 †30 | 9/12<br>30 | 3/4<br>34 | 9/11<br>30 | 6/7<br>30 | 14<br>24 | 40/50<br>90 | 8<br>18 | 7 | 9 | 18·5<br>18·9 | 17·2<br>17·3 | 18·2 | 17·6 | 17 | 17 | 17 | 150 |
| 3/4 | *2 †2 | 6 | *1 †3 | 2/8 | 1/2 | 12 | 25 | 3/7 | 3 | 6 | 13·7 | 13·2 | 13·3 | 13·3 | 11·7 | 11·8 | 40 | |
| 6 | 3 | 15/20 | 10/12 | 7 | 6 | 8/9 | 15<br>40 | 7/8 | ... | ... | 13·8<br>14·1 | 12·2<br>12·8 | 11·6 | 10·6 | 11·3 | 10·6 | | |
| ... | ... | ... | ... | 10 | 18 | 7 | 25 | 7 | 5 | 9 | 16·6 | 16 | 16 | 17 | | | | |
| ... | ... | ... | ... | 6? | 6? | ... | 40 | | | | | | | | | | | |

TABLE III.

| | | Age | | Sternum. | | Second rib. | | Fourth and fifth ribs. | | Sixth rib anteriorly. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | upper | lower | right | left | right | left | right | left |
| Diseases confined to one lung. — Phthisical cavity in the upper lobe of one lung. | 168. L. Fowkes | 27 | phthisical cavity in the right upper lobe, lower lobe not notably affected | 8 | *12 | 5/8 | 12/14 | *3 | 7 | *5 | 6 |
| | 169. T. Bailley | 33 | ditto ... ... | 5/7 | 4 | 2/3<br>35 | 8<br>80 | 0<br>30 | 5<br>60 | *1 †1<br>50 | 5<br>50 |
| | 170. M. Summer | 49 | ditto ... ... | 7 | 3 | 8 | 12 | ... | ... | 5 | 5 |
| | 171. Ann Smith | 59 | ditto ... ... | 6 | *8 | 5/6<br>†1 *6 | 15<br>*1 †? | *3<br>6 *3 | *2<br>6 *4 | 6 | 3 |
| | 172. Sh. Hoffen | 50 | ditto ... ... | 12 | 3 | 18 | 12 | *4 | 10 | 5 | *5 |
| | 173. J. Daft | 65 | ditto ... ... | 9 | *2 †8<br>60 | *1 †3<br>65 | 9<br>40 | *3 †1 | 5 | *2 †4<br>40 | 5<br>60 |
| | 174. Sar. Saywell | 20 | ditto ... ... | 20 | *2 | 20<br>80 | 20<br>60 | 3 | 2 | 4 | 3 |
| | 175. J. C. Searles, patient of Dr. Roe | | ditto ... ... | 6 | 5 | 4/6<br>80 | 12<br>120 | *2 †2 | 6 | 5 | 6 |
| | 176. E. Weaver | | ditto ... ... | 7 | 3 | 5<br>40 | 12<br>60 | *1 †2<br>35 | 4<br>50 | 4 | 5 |
| | 177. Wm. Rossington | 35 | ditto ... ... | 10 | ... | 11 | 15 | 4 | 8 | *4 | 4 |
| Cavities in both lungs, p. 451. | 178a. J. German | 13 | both lungs nearly equally diseased | 3/10 | 4 | 6/15 | 10/20 | 5 | *1 †5 | 3 | 4 |
| | 178b. Ditto, second observation | | ditto ... ... | 6 | *5 | 8/10 | *13 | 6 | 6 | 3 | 3 |
| | 179. Ts. Andrews | 22 | ditto ... ... | 10 | 5 | 15/13 | 9/15 | 6 | 5 | 5 | 5 |
| | 180. Ds. Flanagan | 39 | ditto ... ... | 2/10 | *1 †2 | 4/8<br>15 | 4/8<br>20 | *2†1/3 | 5 | 2 | 5 |

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| Sixth rib, lateral. | | Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. above nipple | | xyphoid cartilage | | Abdomen. | | No. of respirations per minute. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | |
| 16 | 15 | 6 | 4 | 16 | 15 | 15 | 20 | 16 | | | | | | | | | |
| ... | ... | 1 | 4 | ... | 10 | 12 | 30 | 12 | | | | | | | | | |
| ... | ... | ... | ... | 4 | 6 | 6 | 5 | 8 | ... | ... | 11·4 | 12·4 | | | | | |
| ... | ... | ... | ... | 8 | 18 | 24 | 25 | 10 | ... | ... | 12 | 11·5 | | | | | |
| ... | ... | ... | ... | 9 | *2 | ... | 8 | *2 | | | | | | | | | |
| ... | ... | ... | ... | *3<br>30 | 10<br>50 | ... | 30 | | | | | | | | | | |
| ... | ... | ... | ... | 6 | 9 | 5 | 9 | 3 | | | | | | | | | |
| ... | ... | ... | ... | 7 | 8 | 8 | 17 | ... | 5 | 5 | 15·2 | 15 | 14·5 | 14 | | | |
| ... | ... | ... | ... | 11 | 7 | 8 | 28 | 10 | 9 | 6 | 15·3 | 15·6 | 14·8 | 14·8 | | | |
| ... | ... | ... | ... | 8 | 9 | 20 | 35 | 35 | | | | | | | | | |
| ... | ... | ... | ... | 11 | 11 | 12 | *5†15/25 | 5 | | | | | | | | | |
| ... | ... | ... | ... | 10 | 10 | 15 | 20 | 4 | 4 | 4 | | | | | | | |
| 5 | 5 | 12 | 12 | 10 | 10 | 14 | 20 | 20 | 4 | 4 | 14·3 | 14·3 | 13·3 | 13·5 | | | |
| ... | ... | ... | ... | 5 | 5 | 5 | 18 | 8 | 7 | 5 | 17·2 | 17·2 | 17·2 | 17 | | | |

TABLE IV.—*Cases in which the Movements of Respiration were disturbed, or*

| | | | Sternum. | | Second rib. | | Fourth and fifth ribs. | | Sixth rib, anterior. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | upper | lower | right | left | right | left | right | left |
| Pericardial adhesions, p. 483. Enlarged heart, p. 461. Pericarditis, p. 460. | 181. John Weldon | Age 23 pericarditis, slight effusion, acute rheumatism | 9 | *2 †2 | 10 | 9 | 5 | *2 †2 | *3 | *5 |
| | 182. Mary Hibbert | 25 ditto ... ... | *2 †10 | *4 †2 | 18 | 7 | 5 | *2 †4 | 4 | *2 |
| | 183. Wm. Shaw | 15 pericarditis, endocarditis | *1 †3 | ... | 7/10 | *1 †6 | *2 †5 | *3 †2 | 4 | *4 |
| | 184. Mary Bale | 20 endocarditis, pericarditis | 6 | *4 | 12 | 6 | 4 | *2 | 4 | 3 |
| | 185. Fanny Lee, patient of Dr. Walshe | ditto ... ... | 2 | 2 | 6 | 8 | 4 | 0 | 3 | 8 |
| | 186. Wm. Thorley | 20 ditto ... ... | 12 | 2 †2 *4 | 15/20 | 15 | 6/10 | 3 *4 | 10 | 2/4 |
| | 187. George Charlesworth | 16 ditto ... ... | 4 | *2 †2 | 8/12 | 10 | 2 | *1 | *1 †2 | *1 |
| | 188. Emma Benson | 17 ditto ... ... | 5 | *4 | 5/12 | 8/12 | 4 | 1 | *3 †3 | *3 |
| | 189. James Hogg | 42 pulmonic valves obstructed, regurgitant, heart large | 7/9 | 2/3 | 6/8 | 4/8 | 5/6 | 2 | 5 | 2 |
| | 190. Thirza Leaf | 20 aortic regurgitation, heart large, acute rheumatism | 5 | 5 | 7 | 7 | ... | ... | 2½ | 1 |
| | 191. C. Walls | 52 ditto ... ... | 4 | 4 | 2<br>20 | 2<br>20 | 2<br>14 | 0<br>25 | 0<br>14 | 6<br>25 |
| | 192. John Roe | 62 mitral regurgitation, heart large | 11 | 9 | 9/12 | 9 | 4 | 3 | 1½ | 5 |
| | 193. Ann Leavers | ditto ... ... | *1†5/8 | *2 | 15/20 | 6 | 5 | *2 | *2 †5 | *3 |
| | 194. Mary Simmonds | 25 ditto ... ... | 5 | 3 | 4 | 6 | 3 | 2 | 3 | 2 |
| | 195. John Soar | 20 mitral and aortic regurgitation | 6 | 5 | 10/12 | 8/12 | 2 | 1 | 4 | 3 |
| | 196. W. Thorley | 20 second observation endocarditis, pericarditis? and acute rheumatism, partial adhesions? | 6/12 | *3 | 15 | 22 | 10 | 5 | 5/7 | 3/5 |
| | 197a. Wm. Shaw | 14 pericardial adhesion, heart large, acute rheumatism | *4 | fell in | 8 | 8 | 8 | rises on expiration | 6 | about 2 |
| | 197b. Ditto, second observation | ditto, shortly before death | 10 | *2 | 16 | 11 | 7 | 0 | 3 | *3 |
| | 198. Wm. Ellis | 70 pericarditis, pericardial adhesion, heart large | 26/30 | 26/30 | 27 | 25 | 20/27 | *1†20/30 | 20 | 20 |
| | 199. Herbert Bower | 35 pericardial adhesion | *1 †10 | *7 | 18/25 | 10/15 | *3 †7 | *4 †4 | *8 †7 | *8 |
| | 200. John Perry | 25 aortic and mitral regurgitation, heart large, adhesion? | *3/7 | *3/*5 | 10 | 10 | 5/7 | 6 | 5 | 3 |

*rendered abnormal, by Diseases of the Heart and Pericardium,* pp. 460-466.

| Sixth rib, lateral. | | Eighth rib. | | Tenth rib. | | Abdominal. | | | Rhythm. | | Tape measurements. above nipple | | xyphoid cartilage | | Abdomen | | No. of respirations per minute. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| right | left | right | left | right | left | right | centre | left | insp. | exp. | right | left | right | left | right | left | |
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## DESCRIPTION OF PLATE VI.

The figures in this plate are copies of daguerreotype views of the chest of William Rawson, the subject of emphysema and bronchitis, during ordinary respiration, and during deep inspiration.—See p. 404.

Fig. 1.—Ordinary respiration. Fig. 2.—Deep inspiration.

## DESCRIPTION OF PLATE VII.

The figures in this plate are copies of daguerreotype views of the chest of Samuel Redgate, the subject of phthisis, with a large tuberculous cavity in the upper lobe of the left lung.—See p. 444.

Fig. 1.—Ordinary respiration. Fig. 2.—Deep inspiration.

The lines indicate in both plates the outlines of the internal organs; the concentric lines, the situation of the heart's impulse.

# DONATIONS

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ERRATA.

Page 231, line 21, *for* "animal," *read* "animals."

Page 288, line 14, *for* "Its extreme width is nine and a half lines from before backwards. It measures, in the middle line, &c.," *read* "Its extreme width is nine and a half lines. From before backwards it measures, in the middle line, &c."

Page 450, line 13, *for* "they," *read* "it."

Page 450, line 30, omit the first observation in Searle's case.

Page 450, line 35, "Abdomen." 1·50 belongs to the case of Astell, not to that of Parson.

Page 458, line 14, *for* "of pneumonia on the respiratory movements," *read* "of the respiratory movements in pneumonia."

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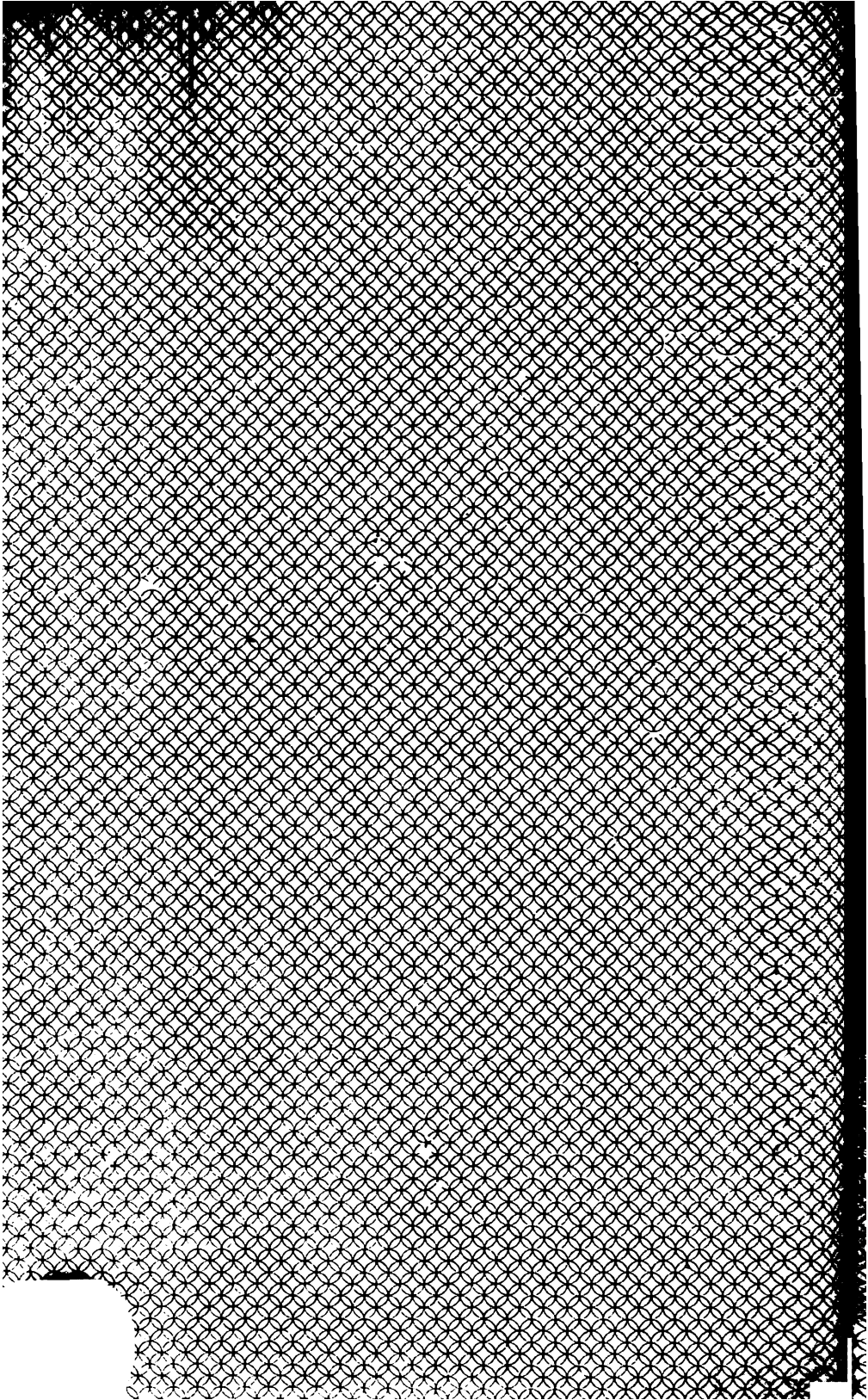

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